ELECTRICAL REVIEW

THE JOHN CRERAR LIBRARY
MAY 1 1958

FERRANTI

FMmP

PREPAYMENT METER

The Ferranti FMmP Prepayment Meter has a strong appeal to the Supply Engineer. The meter is built to meet modern requirements. It is robust in construction, using essential material liberally and having operating characteristics of the highest order.

Ferranti also manufacture the FMmP2 meter with Fixed Charge Collector Mechanism.

FERRANTI LTD · HOLLINWOOD · LANCS

London Office: **KERN HOUSE, 36 KINGSWAY, W.C.2**

F
FERRANTI

Without a shadow...of doubt

install BENJAMIN REGD.

Flurolier Lighting Fittings

To meet Industrial demands for the highest level of illumination in factories, The Benjamin Electric Ltd., offer a range of Flurolier Fittings—in single or continuous runs—for fluorescent lighting. Unobtrusive in appearance, Flurolier Fittings provide a cut-off in accordance with factory regulations; are adaptable to every method of installation; have an exclusive lampholder design and are easily detached for cleaning or maintenance. All in all, Flurolier Fittings are industries' choice *without a shadow of doubt*. *Please send for full details of the complete Flurolier range.*

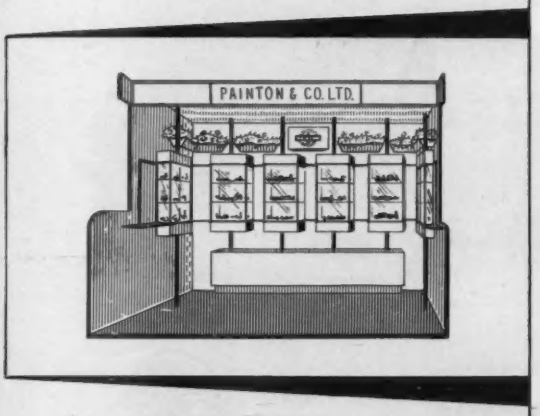
FOR CONSTANT, HARDWEARING PROTECTION FLUROLIER REFLECTORS ARE FINISHED IN 'CRYSTEEL' VITREOUS ENAMEL WHICH GIVES A PERMANENTLY WHITE, HIGHLY REFLECTIVE SURFACE.
FOR LESS ARDUOUS CONDITIONS ASK ABOUT 'PEROPAL' FINISH.

Better lighting by BENJAMIN REGD.

THE BENJAMIN ELECTRIC LTD · TOTTENHAM · LONDON N.17
PHONE: TOTTENHAM 5252 (5 LINES) · GRAMS: BENJALECT SOUTHTOT LONDON
BIRMINGHAM: 3 CORPORATION STREET · BIRMINGHAM 2 · TELEPHONE: MIDLAND 5197
LEEDS: 49 BASINGHALL STREET · LEEDS 1 · TELEPHONE: LEEDS 22579

Smee's 117

R.E.C.M.F. EXHIBITION Grosvenor House, London April 14th–17th STAND Nº 42



MAKERS OF :

ATTENUATORS AND FADERS

STUD SWITCHES

TOGGLE SWITCHES

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HIGH STABILITY CARBON RESISTORS

"METLOHM" METAL FILM AND "FIBERLOY" GLASS FIBRE RESISTORS

FIXED AND ADJUSTABLE WIREWOUND RESISTORS

MIDGET R.F. CHOKES

WIREWOUND POTENTIOMETERS

KNOBS, DIALS AND POINTERS

TERMINALS

PLUGS AND SOCKETS

STAND Nº 209 I.E.A. EXHIBITION Olympia April 16th—25th

PAINTON

Painton & Co. Ltd.
KINGSTHORPE NORTHAMPTON.
Tel: 32354-5-6 Telegrams 'Ceil, Northampton'

The first Crompton Parkinson self-regulating alternators with 'Magnicon' excitation have now many years service to their credit. As news they are dead: as alternators, still very much alive.

What is new — and still live and exciting news — is the upward extension of the range: the latest Crompton Parkinson 'Magnicon' excited alternators are available with outputs up to 350 kVA.

The full range of Crompton Parkinson alternators extends up to 1500 kVA — and all have the benefit of manufacturing experience that goes back to the earliest days of electric power generation.

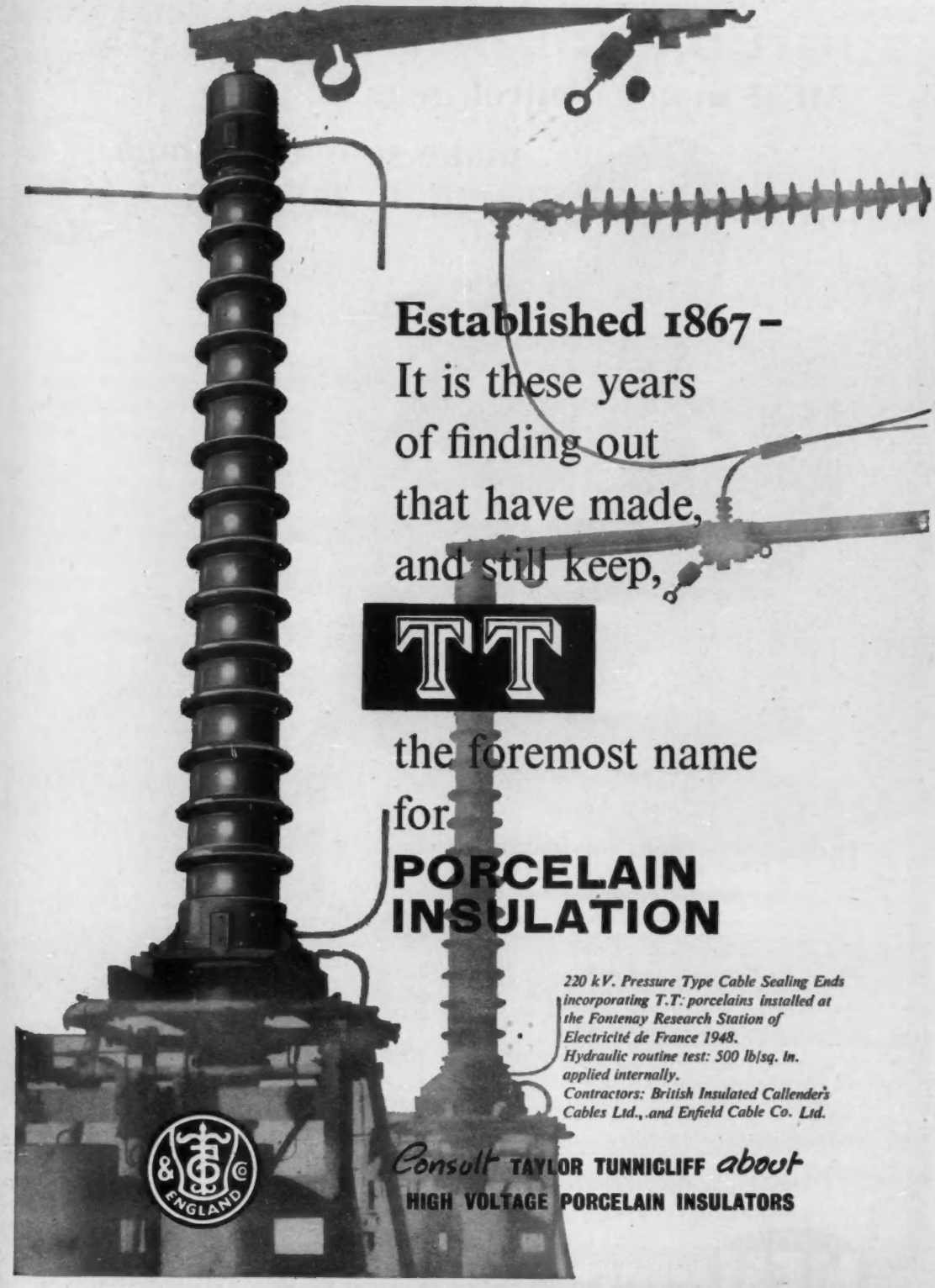
Crompton Parkinson
LIMITED

Member of the Nuclear Power Consortium:
ATOMIC POWER CONSTRUCTIONS LTD.

MAKERS OF ELECTRIC MOTORS OF ALL KINDS · INSTRUMENTS
ALTERNATORS AND GENERATORS · SWITCHGEAR
B.E.T. TRANSFORMERS · CABLES · CEILING FANS
LAMPS · LIGHTING EQUIPMENT · BATTERIES
STUD WELDING EQUIPMENT · TRACTION EQUIPMENT

ELECTRICAL EQUIPMENT

CROMPTON PARKINSON LIMITED, CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2



Established 1867 –
It is these years
of finding out
that have made,
and still keep,

TT

the foremost name
for

PORCELAIN INSULATION

220 kV. Pressure Type Cable Sealing Ends incorporating T.T. porcelains installed at the Fontenay Research Station of Electricité de France 1948. Hydraulic routine test: 500 lb/sq. in. applied internally. Contractors: British Insulated Callender's Cables Ltd., and Enfield Cable Co. Ltd.

Consult **TAYLOR TUNNICLIFF** *about*
HIGH VOLTAGE PORCELAIN INSULATORS

TAYLOR TUNNICLIFF & CO. LTD., Head Office: EASTWOOD · HANLEY · STOKE-ON-TRENT · STAFFORDSHIRE
Telephone: Stoke-on-Trent 25272-5. · London Office: 125 HIGH HOLBORN, W.C.1. Telephone: Holborn 1951-2

MEM motor control gear helps to make so many things

These Lotus shoes for instance

The Lotus shoe factory in Northampton is one of the most modern in the country. For this reason you will find it is extensively equipped with MEM motor control gear and switchgear. Nearly every working bench, for example, has a MEM motor starter. Most of the leading industrial concerns are big users of MEM equipment. This is not surprising when you remember that MEM are leaders in their own field too. MEM equipment is very simple and robust in design. It is extremely reliable in performance, easy to maintain and offers today's best value for money.

The final assembly section of the MEM Tyseley works where castings, pressings, mouldings and other components meet to make the finished product.

MEM MIDLAND ELECTRIC MANUFACTURING CO. LTD · TYSELEY · BIRMINGHAM 11

25 kW continuous output

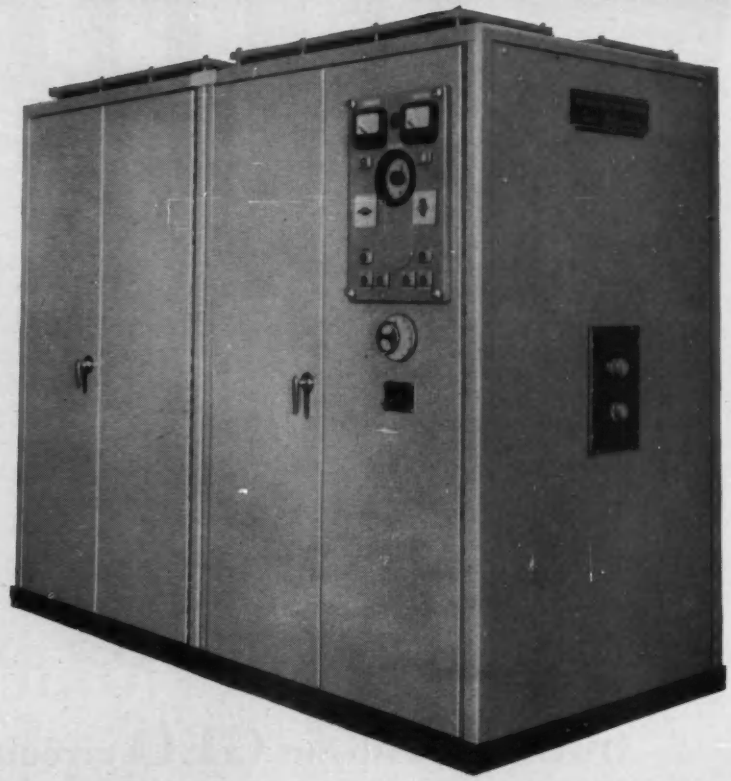
with the

GENERAL PURPOSE INDUCTION HEATER

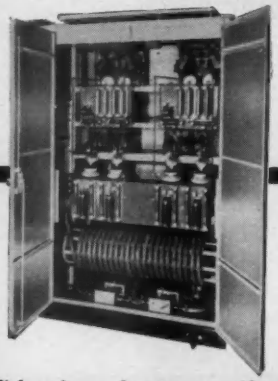
In numerous industrial processes, induction heating provides results that would otherwise be impracticable or unobtainable—particularly where heat-effect must be strictly localised and rigidly controlled.

The new BTH high-frequency generator has been designed for the widest possible range of industrial applications. It is quick and economical in operation—there is no waste heat, and the effect of heat on other parts of the work is minimised. Clean, cool, and fumeless in operation, it readily lends itself to fully automatic operation in a production line.

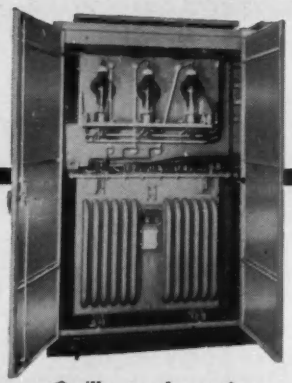
Write for booklet DL5857-3



Type FA27A general-purpose high-frequency generator. Continuous rating: 25 kW. Peak intermittent (50% duty cycle): 30 kW. Output frequency: 400 k/cs. Supply: 3 phase, 50/60 cycles, 380/440 volt.



High voltage thyratron rectifier and transformer section.



Oscillator valve section.

See this new equipment working at
STAND No. 508
INSTRUMENTS, ELECTRONICS & AUTOMATION EXHIBITION, OLYMPIA — 15TH - 26TH APRIL

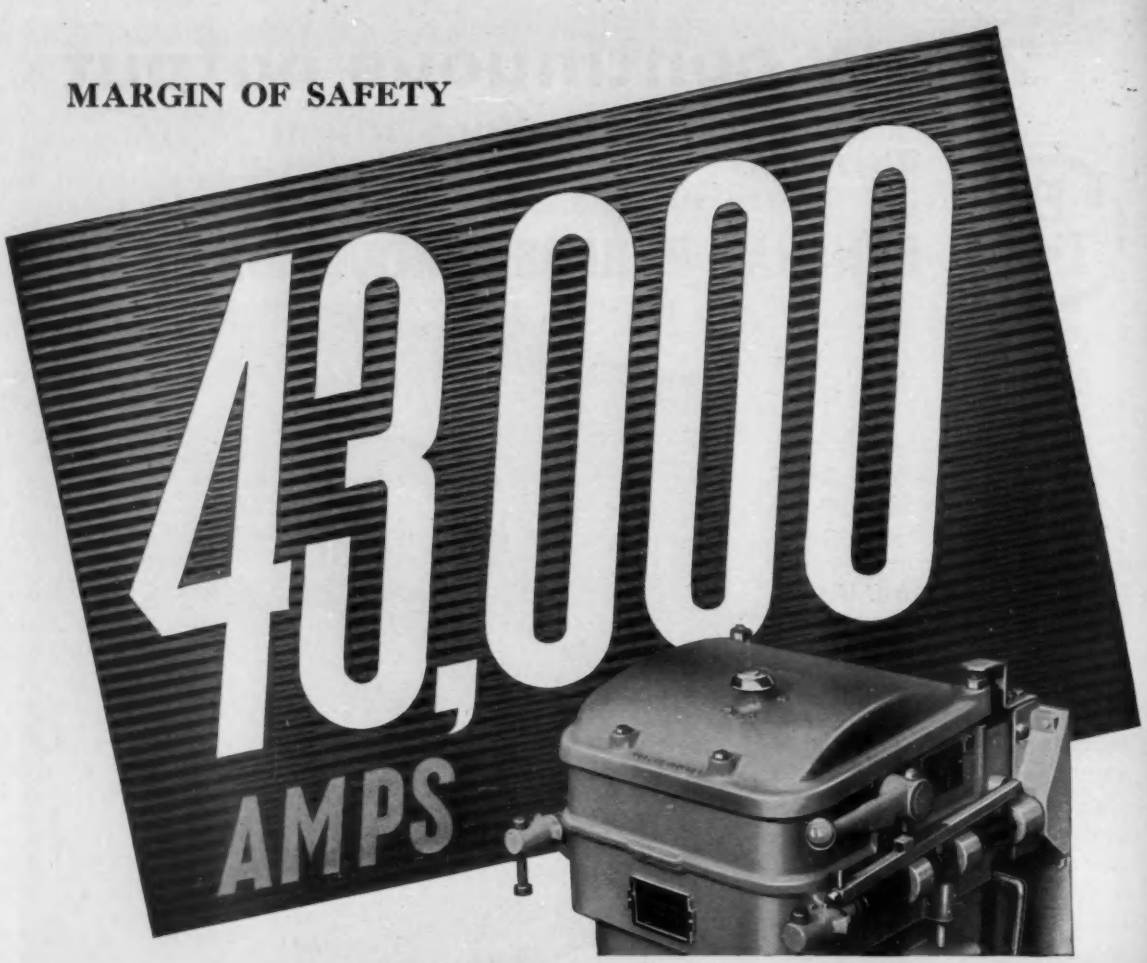
BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · RUGBY · ENGLAND

an A.E.I. Company

A5227

MARGIN OF SAFETY



600 amp Ellison GEO circuit breaker cleared 43,000 amps on A.S.T.A. test (to BS. 116 : 1952)

Ellison GEO circuit breakers are A.S.T.A. tested in accordance with BS. 116 : 1952. During this test, the 600 amp size had to clear 43,000 amps on 600 volts in the following sequence :- *Break; 3 minutes interval ; make and break ; 3 minutes interval ; make and break.* The peak making current associated with this duty is 110,000 amps. Test data for this and for the other sizes of Ellison GEO circuit breakers will gladly be supplied on request.

GEORGE ELLISON LIMITED BIRMINGHAM ENGLAND

Continuing a Tradition

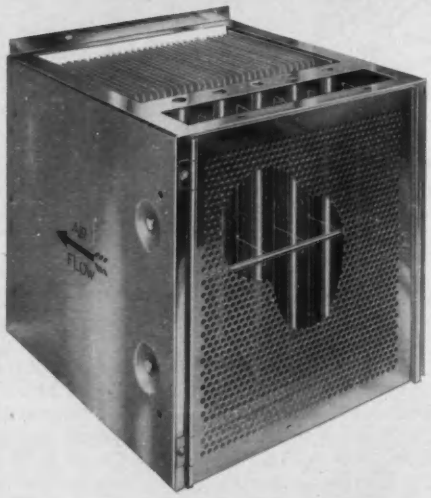
776

Some of the many applications for

Precipitron

REG. TRADE MARK
SOLE LICENSEES

ELECTROSTATIC AIR CLEANER



PRECISION ENGINEERING
TEXTILE MANUFACTURE
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PHARMACEUTICAL PRODUCTS
MANUFACTURE AND PROCESSING OF PHOTOGRAPHIC MATERIALS
PLASTICS INDUSTRIES
BREWING
OFFICES AND PUBLIC BUILDINGS
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ATOMIC ENERGY ESTABLISHMENTS
FINISHING INDUSTRIES
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TELECOMMUNICATIONS
FOOD MANUFACTURE

Some of the many users . . .

SELFRIDGES LTD.
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BOOTS PURE DRUG CO. LTD.
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PRECIPITRON removes all atmospheric impurities down to .01 micron from the air supply to air conditioning and heating and ventilating systems. Thousands of PRECIPITRON Filters have been installed in factories of all kinds, offices, hospitals, etc. to meet the need for really clean air supplies.

The only British PRECIPITRON is fabricated and tested by skilled craftsmen in our Manchester Works. It is the finest air cleaner available, and its application is backed by the extensive experience and technical knowledge of Sturtevant engineers in the field of electrostatic air filtration.

For further particulars write for our publication U.7106.

STURTEVANT ENGINEERING CO. LTD.
Southern House, Cannon Street, London, E.C.4

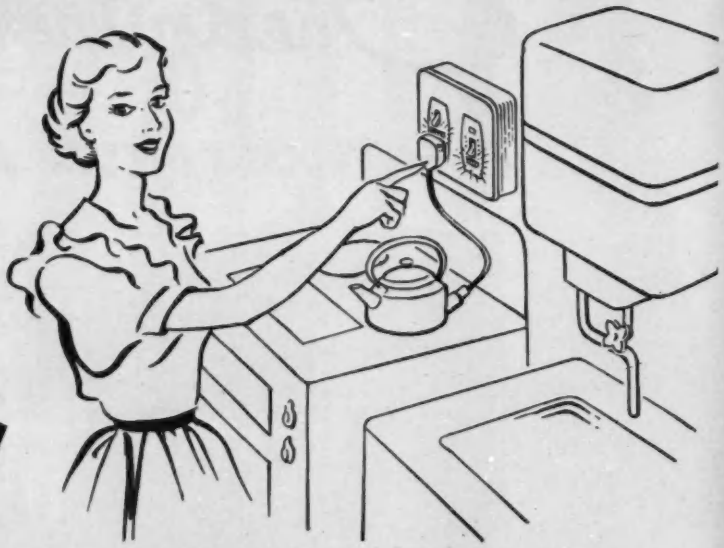
AUSTRALIA

STURTEVANT ENGINEERING CO. (AUSTRALASIA) LTD. 400, SUSSEX STREET, SYDNEY, N.S.W.

Volex Control Units and Isolating Switches

INSULATED COVER
With or without Pilot Light

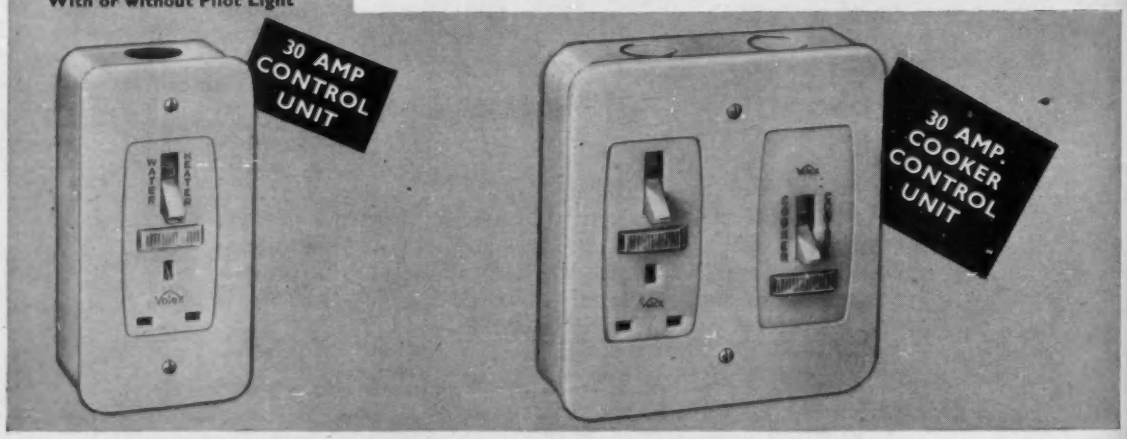
METAL CLAD
With or without Pilot Light



It is impossible to detail here the vast range of these extremely adaptable 30 amp. D.P. Isolating Switches and Control Units. We therefore invite you to send for our illustrated leaflet giving full particulars of complete range and prices.

Insulated cover types are available in Cream or Brown finish and metal clad types, either flush or surface mounting in attractive Cream stove enamel finish with optional alternatives of satin chrome plates.

Available from your usual wholesale suppliers.



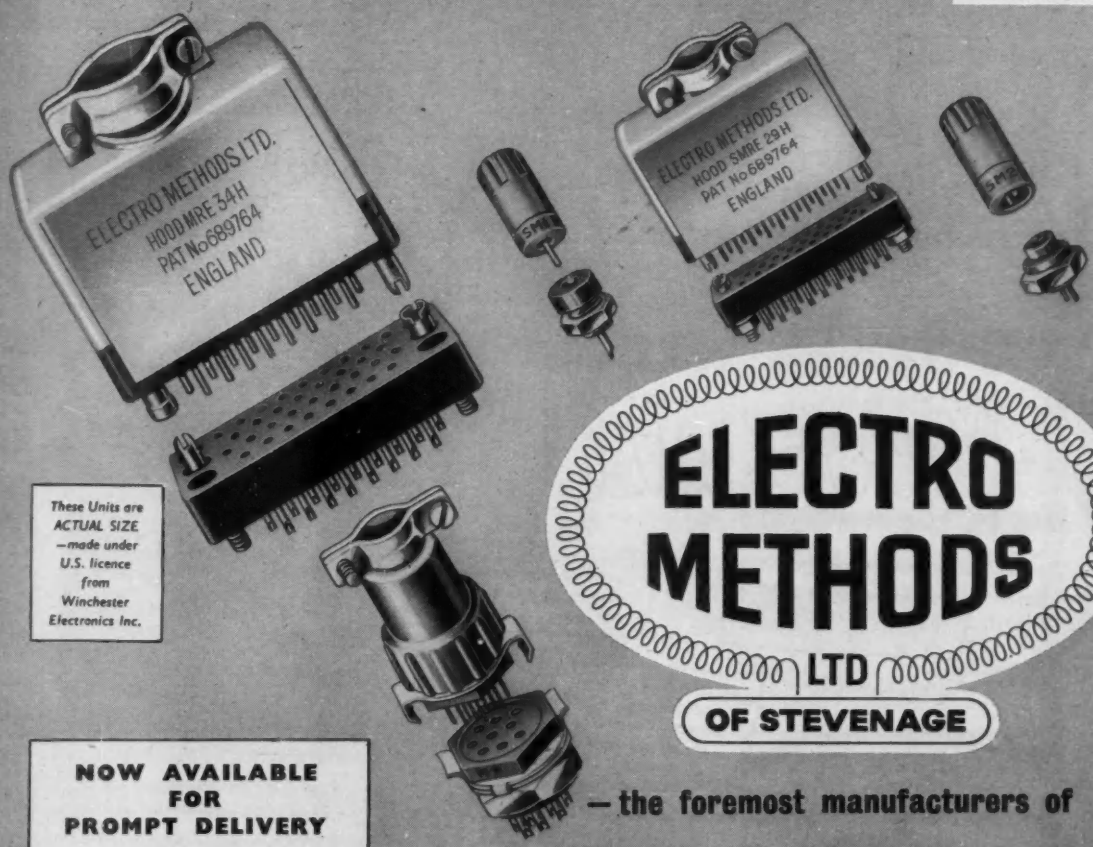
METAL CLAD
With 13 amp. 3 pin Sub-circuit.
With or without Pilot Light.

METAL CLAD
With 13 amp. 3 pin Switched Socket Outlet.
With or without Pilot Light.

VOLEX ELECTRICAL PRODUCTS LTD.
SALFORD 6

Telephone : PENDLETON 4373

Telegrams : VOLEXPROD. Salford 6



These Units are ACTUAL SIZE —made under U.S. licence from Winchester Electronics Inc.

ELECTRO METHODS LTD OF STEVENAGE

— the foremost manufacturers of

miniature connectors

NOW AVAILABLE FOR PROMPT DELIVERY

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SERIES 'MRE'
with 7, 14, 18, 26, 34 & 50 contacts
•
Rigid top or side-entry
ALUMINIUM HOODS
complete with cable-clamps
•
VIBRATION LOCKS
for 7 to 34 contact top-entry hoods only

* *

SERIES 'SMRE'
with 7, 14, 20, 26, 29 & 34 contacts
•
Rigid top-entry
ALUMINIUM HOODS
complete with cable-clamps

* *

SERIES 'M'
with 5, 7 & 9 contacts
•
Rigid top-entry
MELAMINE HOODS
complete with cable-clamps
•
Locking device optional

* *

SERIES 'SM'
with 1 and 2 contacts
•
Rigid top-entry
MELAMINE HOODS

GOLD-PLATED CONTACTS
made from spring-tempered phosphor-bronze
provide low contact-resistance, prevent corrosion and facilitate soldering.

MELAMINE MOULDINGS
conforming to B.S.S. 1322
provide high arc-resistance, high dielectric and mechanical strength.

Full technical data and illustrated leaflets forwarded on request:
ELECTRO METHODS LTD.
24-48 Caxton Way, Stevenage, Herts.
Telephone: Stevenage 780-4

I.E.A. EXHIBITION
April 16—25th
Stand No. 610 OLYMPIA

Pocket size... pocket wise!

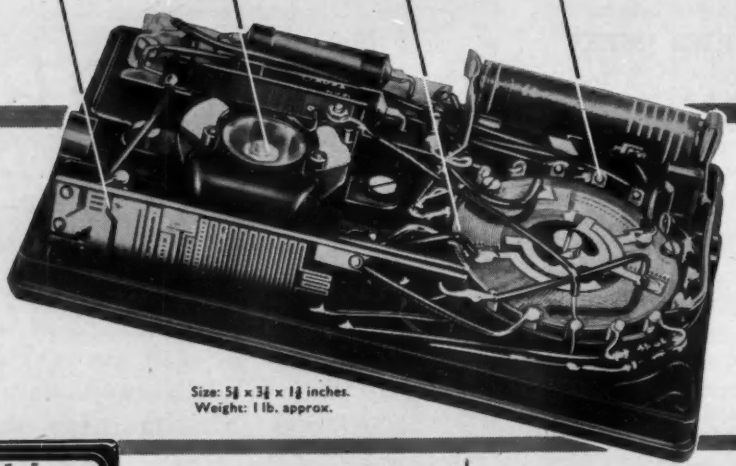
This sturdy multi-range test meter is remarkable for the wide range of test facilities which have been so neatly incorporated. Full advantage has been taken of printed resistor techniques to produce a compact instrument of low weight.

Printed resistance panel for universal meter shunt.

Composite printed resistors and auxiliary switch.

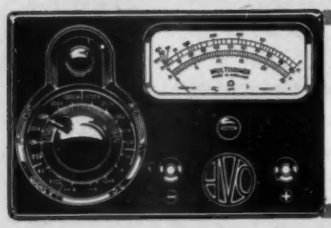
Meter movement is enclosed to give protection against the infiltration of dust.

Robust range switch similar to that used in the famous Avo-Meter. Eighteen fixed silver-plated contacts embedded in a ring of high-grade moulding material are swept by a double contact rotor arm.



AVO
Regd. Trade Mark.

Size: 5⅝ x 3¼ x 1⅞ inches.
Weight: 1 lb. approx.



7 D.C. Voltage Ranges: 0-1,000 V.
5 A.C. Voltage Ranges: 0-1,000 V.
5 D.C. Current Ranges: 0-1A.
2 Resistance Ranges: 0-20,000Ω. 0-2MΩ.

Sensitivity:
10,000Ω/V on D.C. voltage ranges.
1,000Ω/V on A.C. voltage ranges.

Accuracy:
3% of full scale value on D.C.
4% of full scale value on A.C.
For a small additional charge, instruments can be supplied to a higher degree of accuracy.

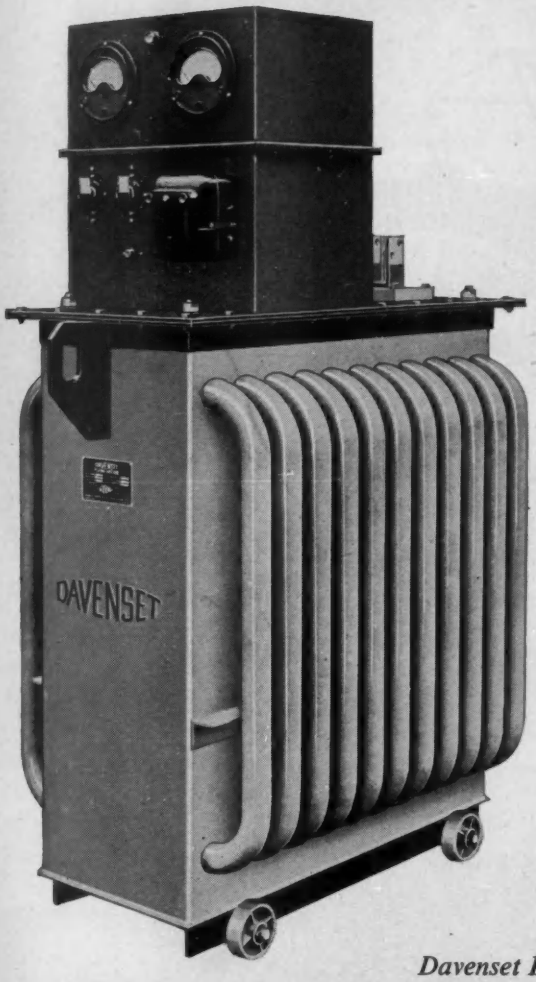
THE MULTIMINOR

19 Ranges · Single Knob Control · £9:10s.
List Price:
Complete with test leads and clips. Leather case if required 32/6.

● **Write for fully descriptive leaflet.**

AVO Ltd. AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · S.W.1.
VICtoria 3404 (9 lines)

Power for plating



- No maintenance of any type needed.
- No moving parts to break down
- Close control of plating voltage by transformer tapping switches

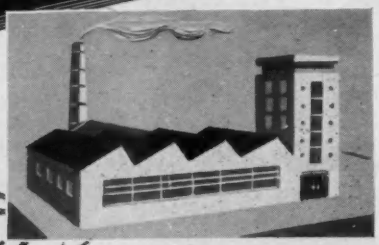
- Simple to install alongside bath
- No rheostats to wear out
- Conservatively rated for continuous duty at full load

- Low in price—high in efficiency
- Popular sizes always in stock
- Quick delivery

Davenset Plating Rectifiers are being used extensively as individual units or in banks in the U.K. and overseas

DAVENSET TRANSFORMER RECTIFIER SETS
for **CONTINUOUS DUTY AT FULL LOAD**

PARTRIDGE WILSON & COMPANY LIMITED · LEICESTER · ENGLAND



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ARE AS FOLLOWS:

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Associate Members

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THE STEEL TUBE & CONDUIT CO. (Middlesbrough) LTD.

In every kind of electrical installation use

A.S.C.M. CONDUIT

to obtain reliability and maximum safety for all

ASSOCIATION OF STEEL CONDUIT MANUFACTURERS · 96 HAGLEY ROAD · BIRMINGHAM 16

RAWLPLUG

DURIUM

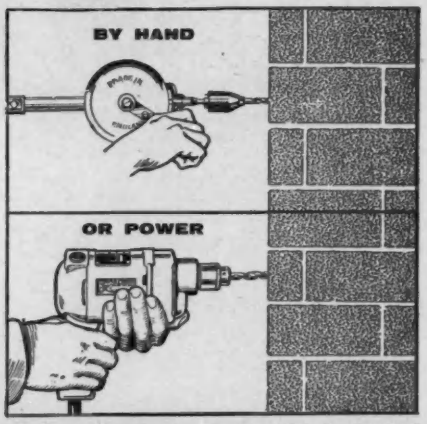
Registered Trade Mark

The world's FASTEST masonry drill

DURIUM is the drill that revolutionized masonry drilling, staggering the industrial user with its amazing speed of penetration and sharp, silent, easy-cutting *accuracy!* With its tough, almost diamond-hard Durium tip, and its patented rapid-helix flute to force out spoil and prevent clogging, the Durium Drill penetrates masonry of all kinds at a speed unequalled anywhere in the world.

and the most durable

Just as important to your costs is the extraordinary *durability* of Durium Drills. Remember that masonry is an *abrasive* material which quickly ruins ordinary drills. The astonishing *toughness* of the Durium tip, and the stronger backing of steel given it by the specially designed flute, makes Durium Drills the world's most durable masonry drill.



R.P.I. ELECTRIC DRILL This is the ideal power tool for use with Durium Drills. With a full load speed of 450 r.p.m. it combines high torque with a weight of less than 5 lbs.

Free resharpening service

When, at long last, your Durium Drill begins to lose its keenness, return it to us with the complimentary voucher supplied with it, and we'll re-sharpen it FREE! Write now for full details of these fastest-of-all masonry drills.

Sold in the bright orange and blue metal container clearly marked Rawlplug Durium.

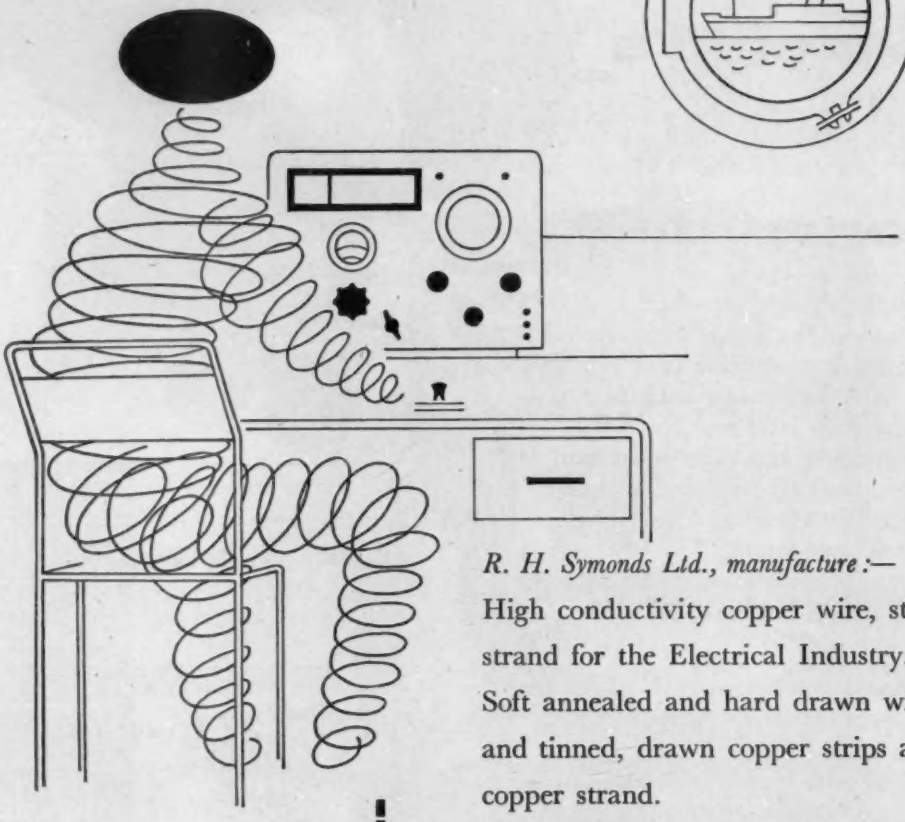
Look for the name DURIUM on the drill shank, no other is a genuine DURIUM Drill.

THE RAWLPLUG COMPANY LTD., CROMWELL ROAD, LONDON, S.W.7

COPPER

THE LIVE WIRE IN

COMMUNICATIONS



R. H. Symonds Ltd., manufacture:—
High conductivity copper wire, strip and strand for the Electrical Industry.
Soft annealed and hard drawn wires, plain and tinned, drawn copper strips and copper strand.
Please telephone your enquiries to Abbey 2771/5 or write to the address below.

SUPPLIERS TO BRITISH RAILWAYS, GOVERNMENT DEPARTMENTS, ELECTRIC CABLE MANUFACTURERS, TRANSFORMER AND ELECTRICAL MOTOR MANUFACTURERS AND OTHER USERS.

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47 VICTORIA STREET, LONDON, S.W.1.
Works: Enfield, Middlesex.

Q. What does it cost to drive a 10 kW Generator from a 14/22 h.p. Armstrong Siddeley Air Cooled Diesel?

A. $0.01385 (1.175d.) per kW/hour *

ACTUAL COSTS
FOR 2606½ HOURS RUNNING WERE:

Diesel fuel (less tax: 1178 gals.)	$259.27
Lubricating oil, filters etc.	$81.71
Spare parts (fuel filter assembly)	$20.35
Fuel consumption (Gals/Hour)	0.441

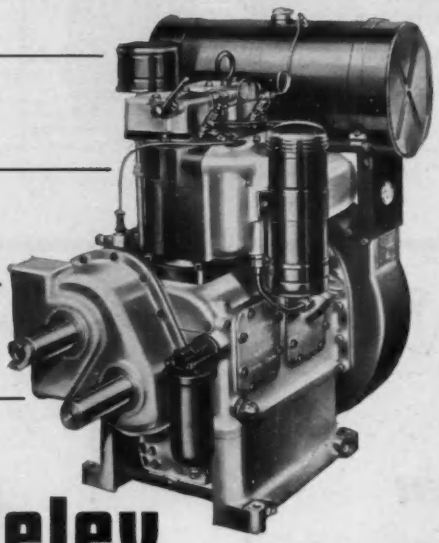
* *Figure supplied by Gt. Raymond Paper Co. of Lac Brûlé, Canada.*

YEARS OF KNOW-HOW: The diesel engines are manufactured with the same precision as the Hawker Siddeley Group's world-famous aero engines.

MATERIAL-CHECKED: Armstrong Siddeley experts regularly visit suppliers of materials and components to check on their quality controls

PRODUCTION-CHECKED: Engines are taken off the production line at random and given a fifty-hour running test.

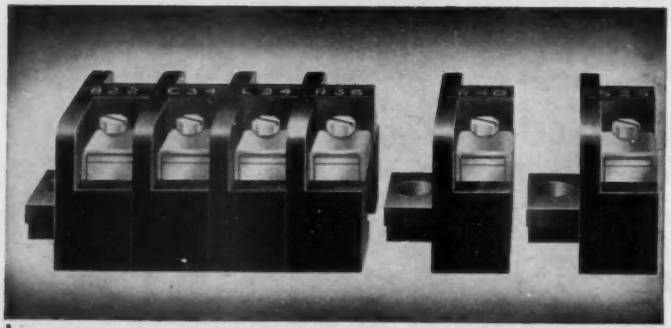
THERE IS NO MORE RELIABLE DIESEL ENGINE.
Three models: 6-11 h.p., 14-22 h.p., 20-33 h.p.
Write now for brochures.



Armstrong Siddeley
AIR COOLED Diesels

ARMSTRONG SIDDELEY (BROCKWORTH) LTD • HUCCLECOTE • GLOUCESTER

MEMBER OF THE HAWKER SIDDELEY GROUP



Interlocking Terminal Blocks, 10–75 amp.

METWAY: MULTI-LOCKWAY

to B.S.S. & C.S.A. Specifications

Our new Brochure contains particulars of hundreds of types of Terminal Blocks for every application. Every Engineer should ask for BROCHURE NBQ/10.

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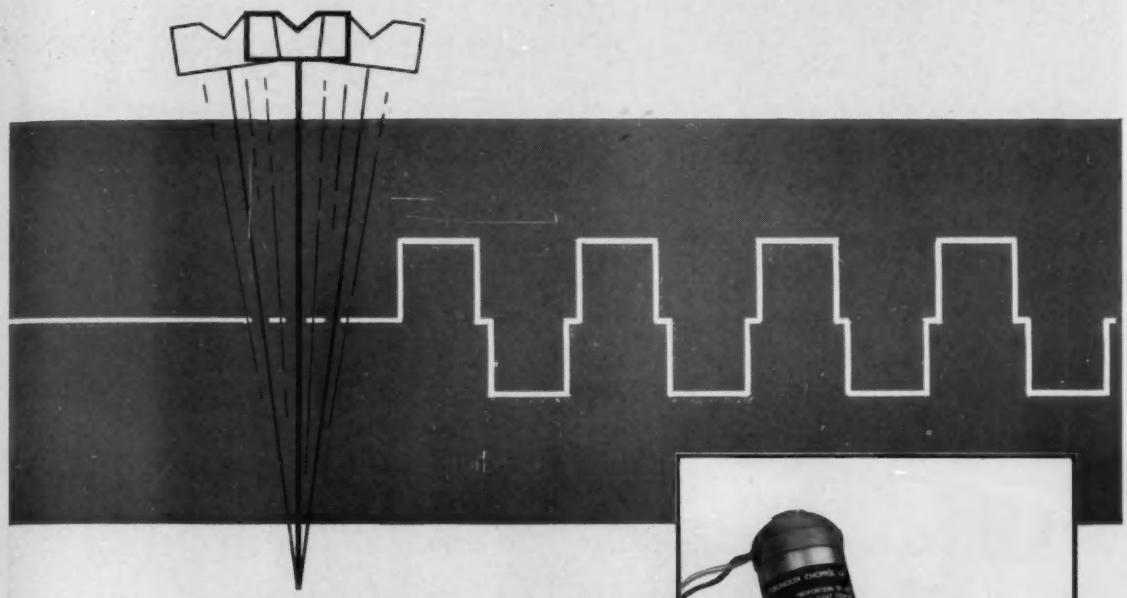

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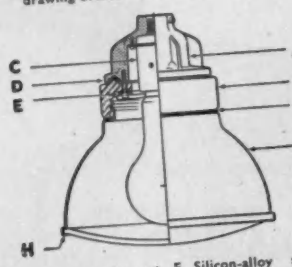

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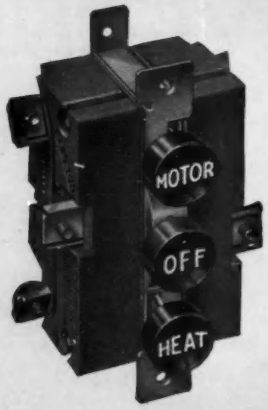

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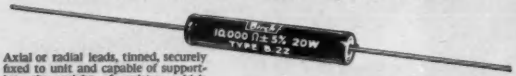

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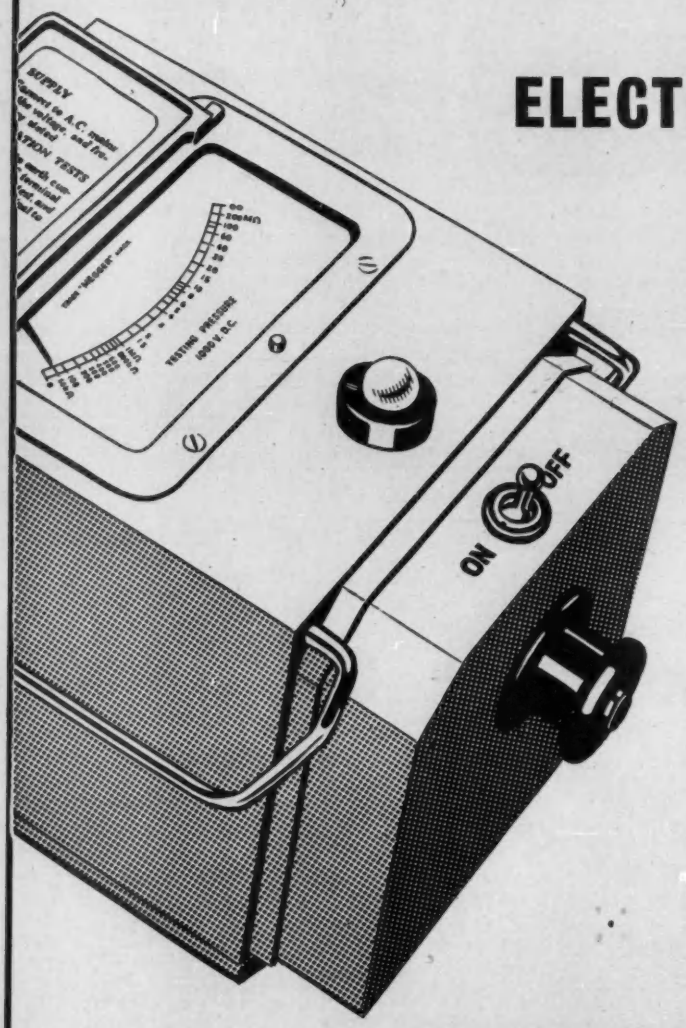

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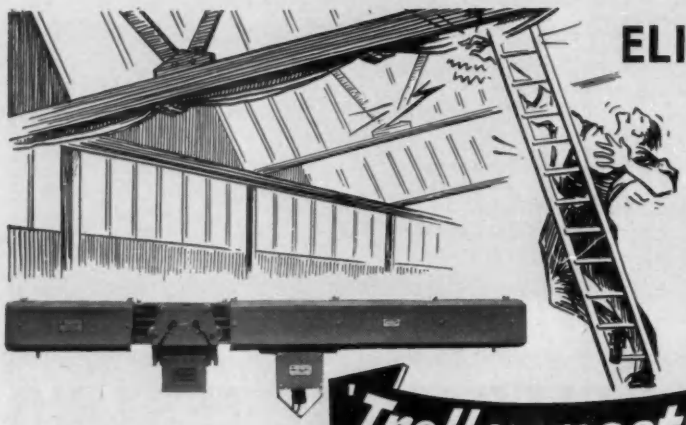

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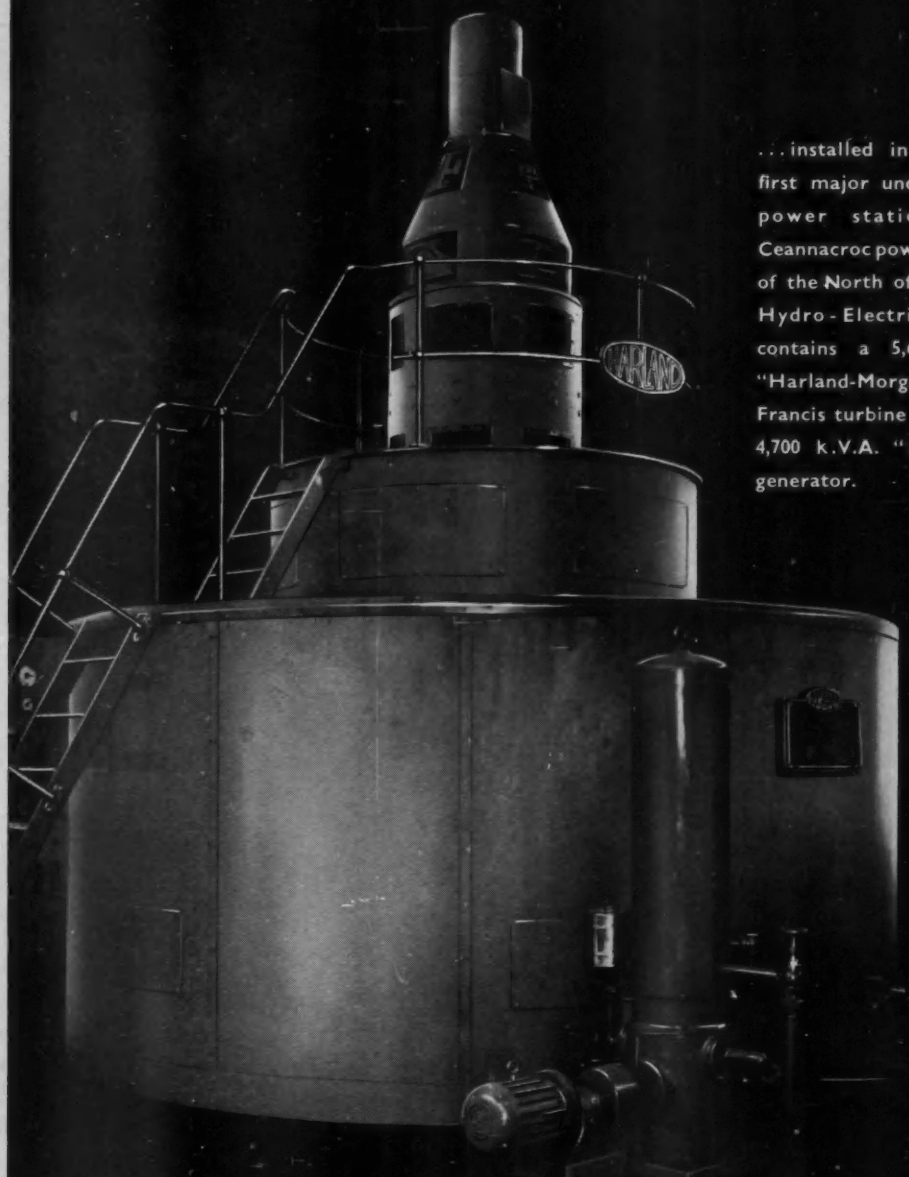

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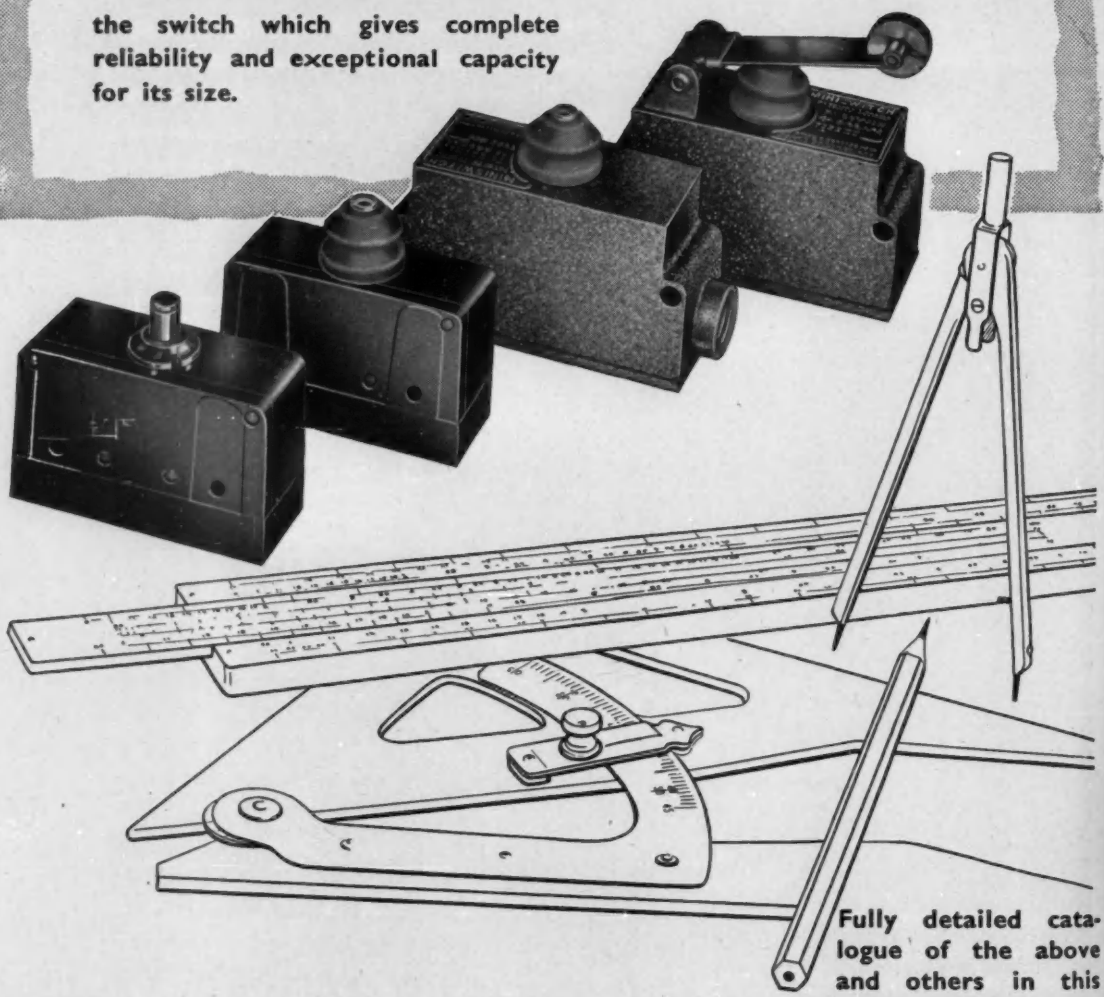

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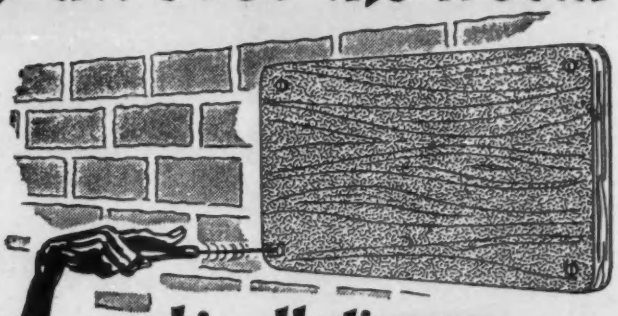

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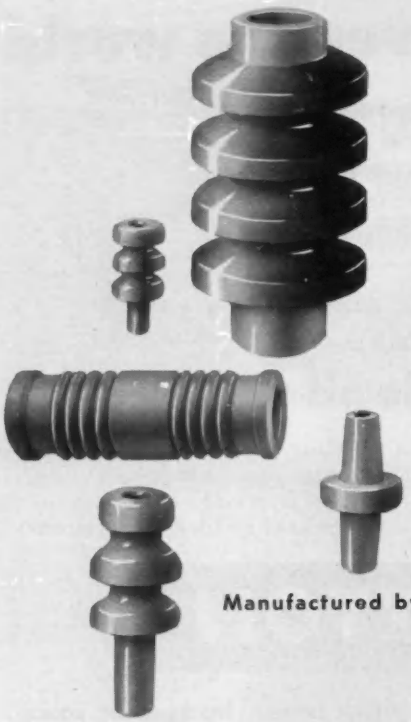

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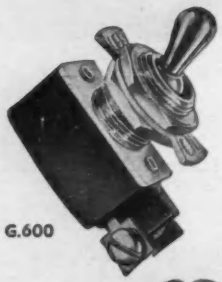

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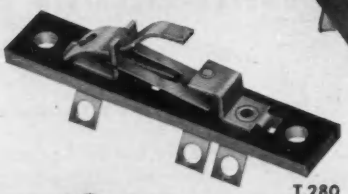

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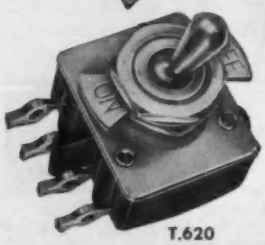

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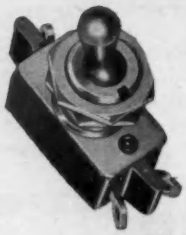

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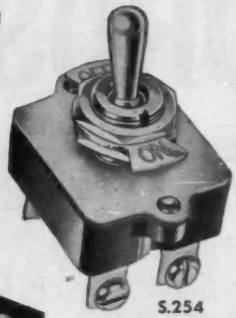

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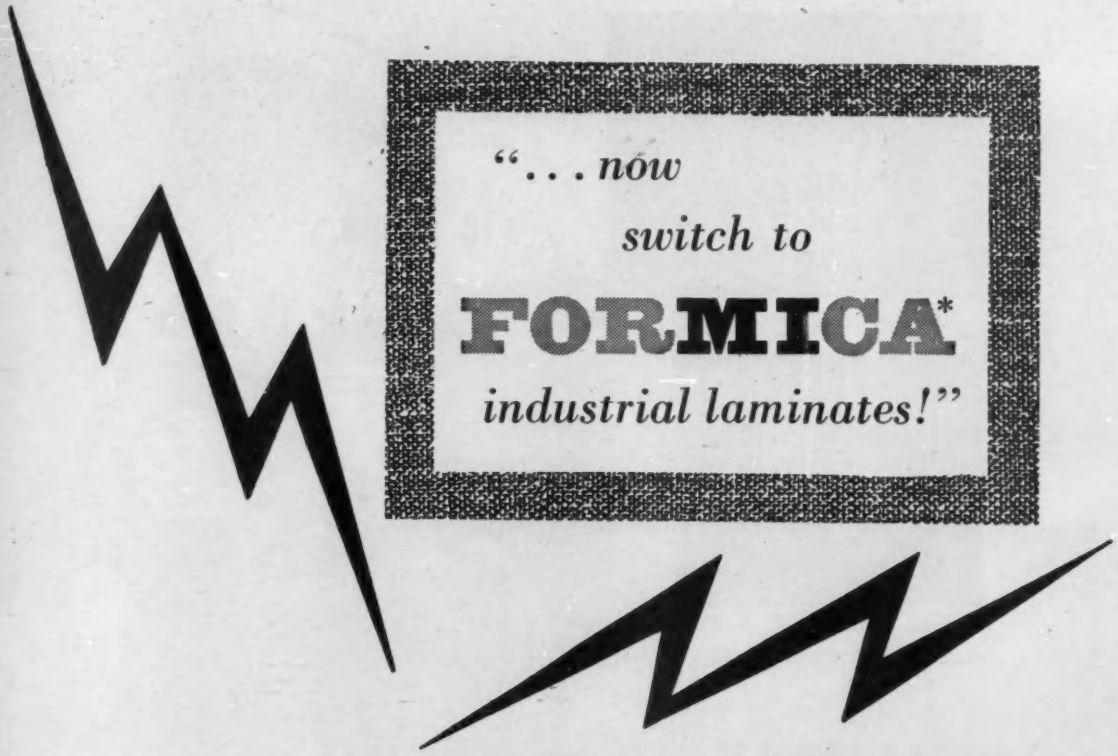

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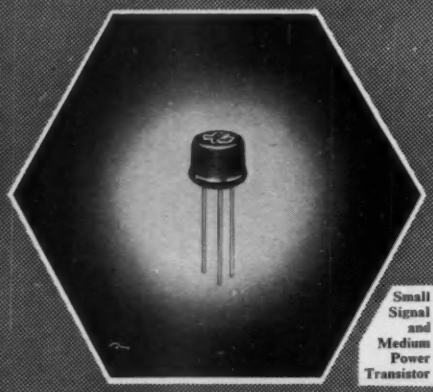

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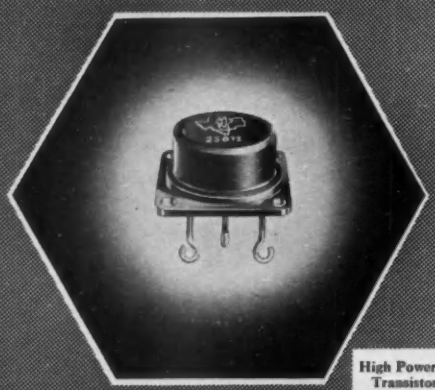

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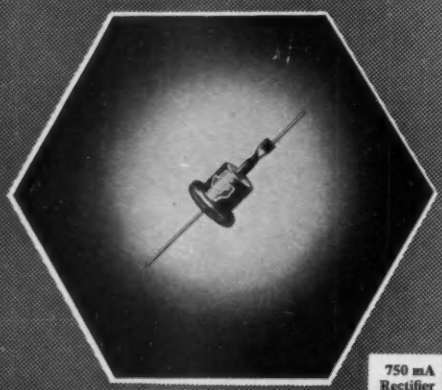

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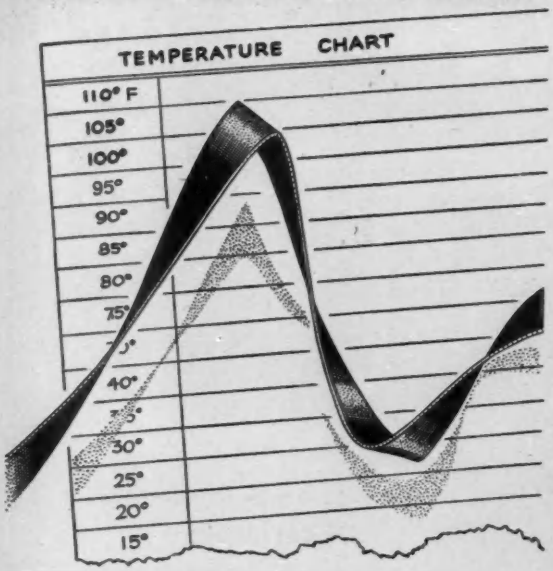

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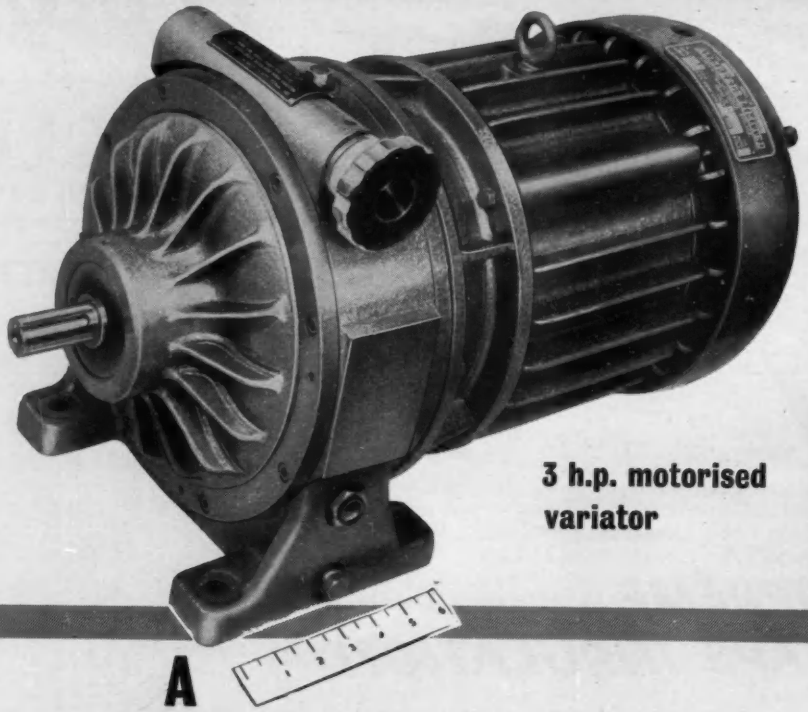

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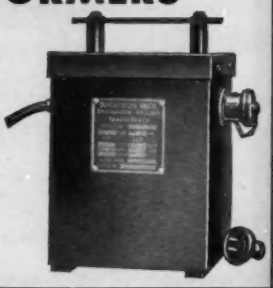

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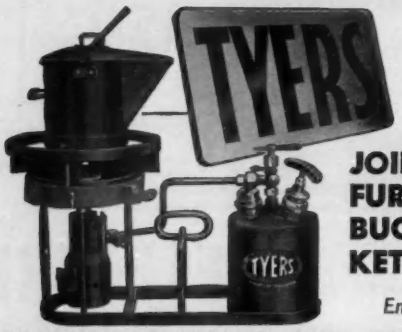

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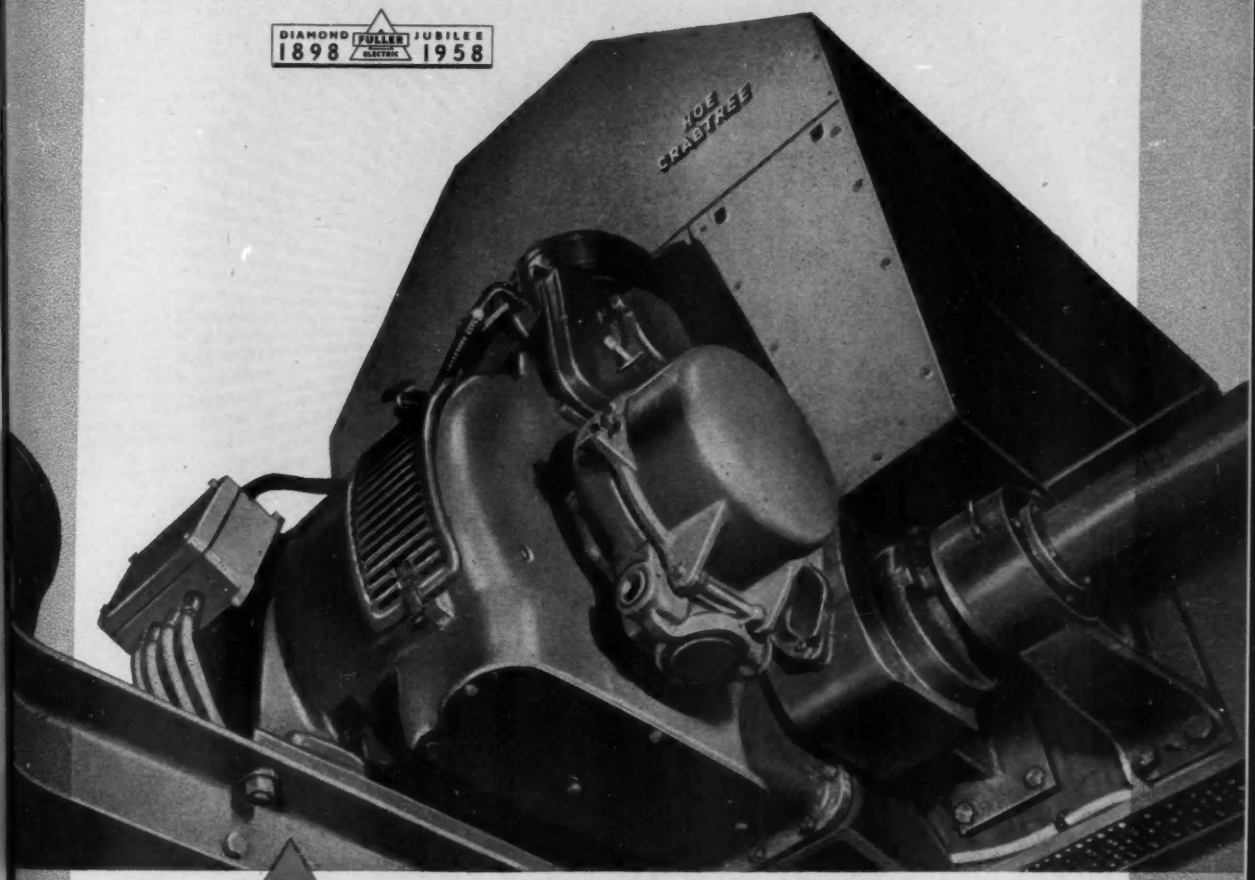

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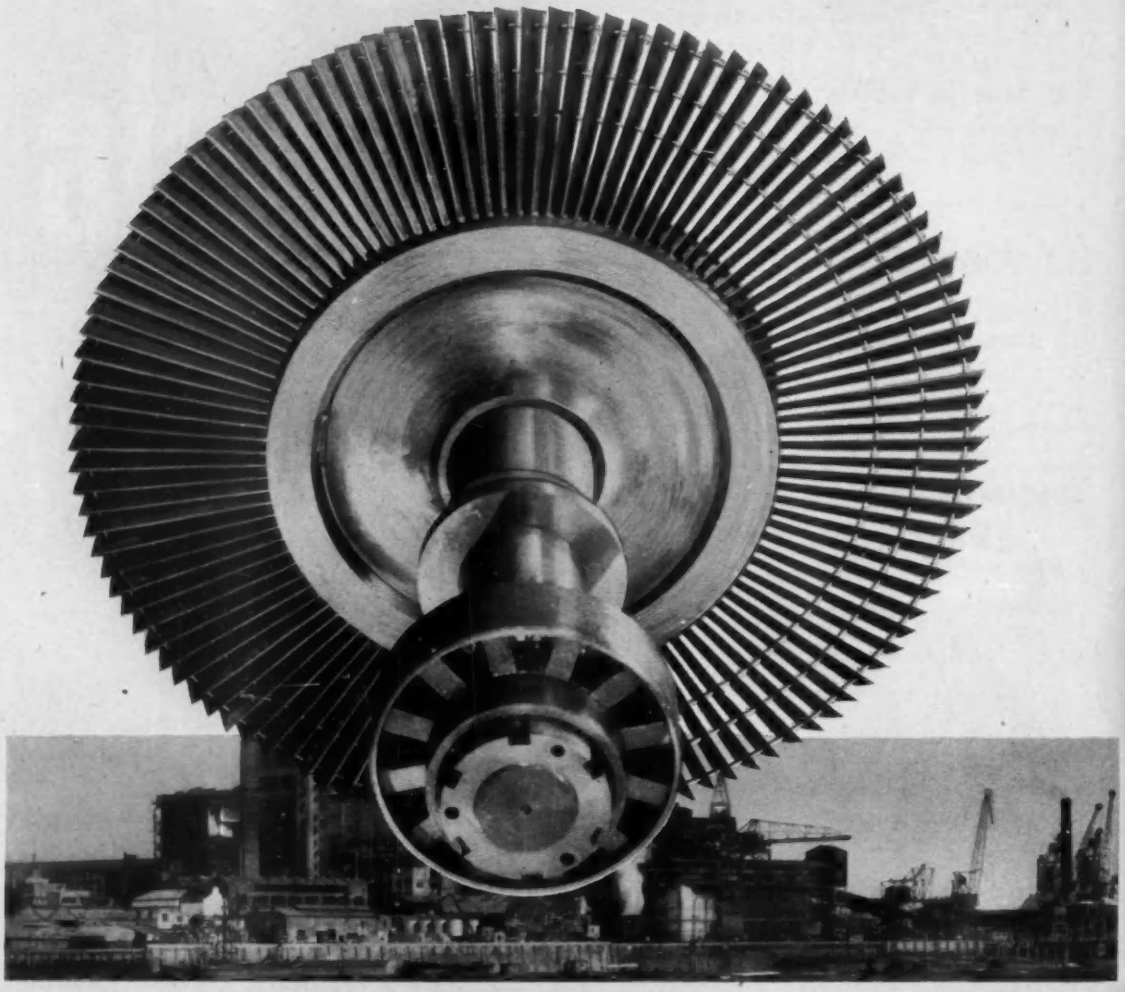

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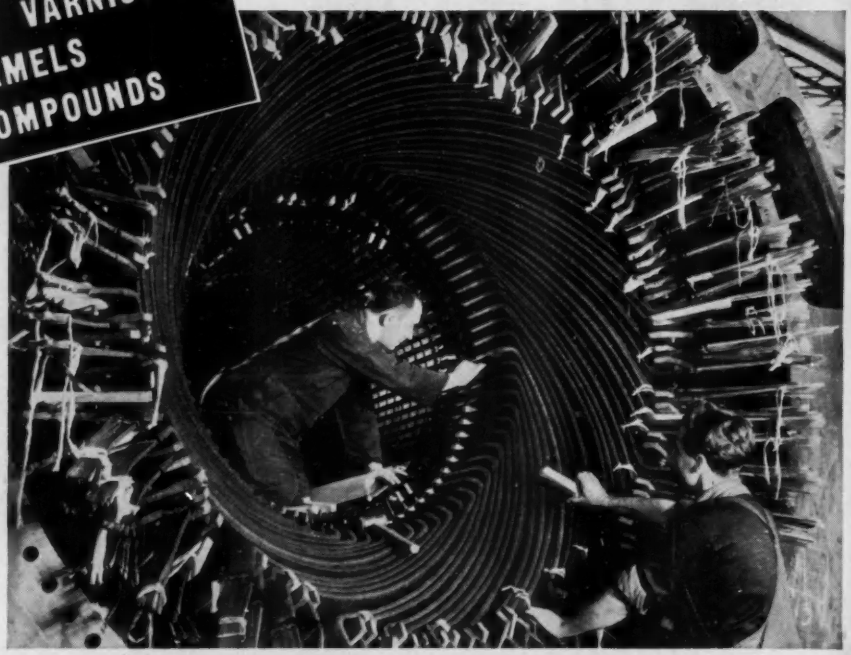

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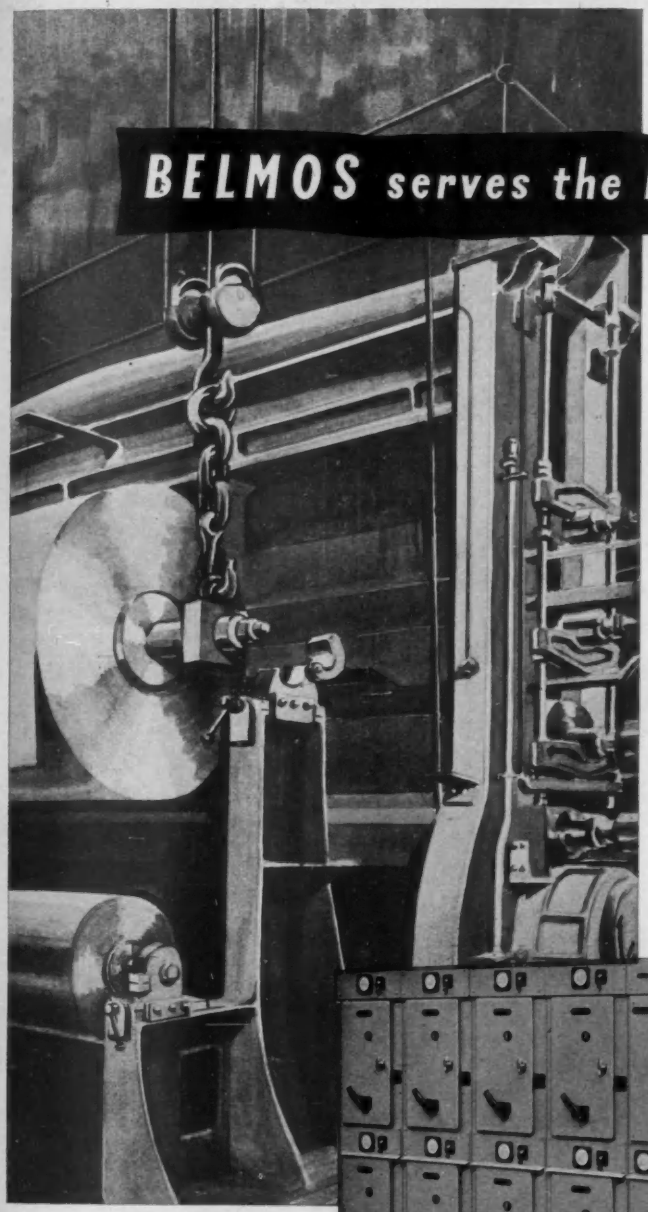

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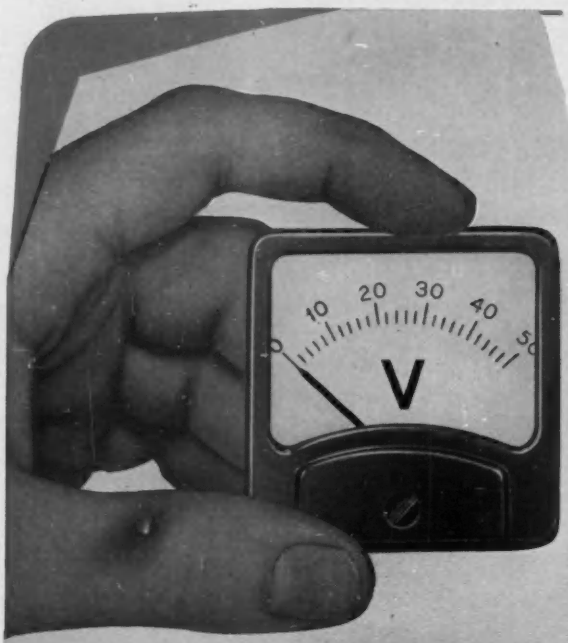
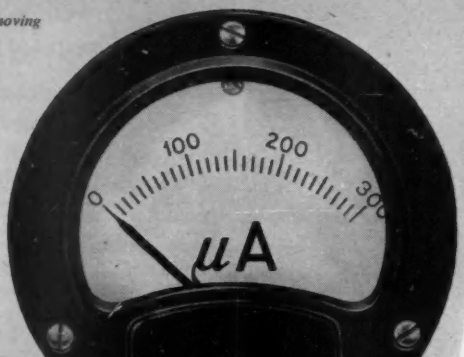
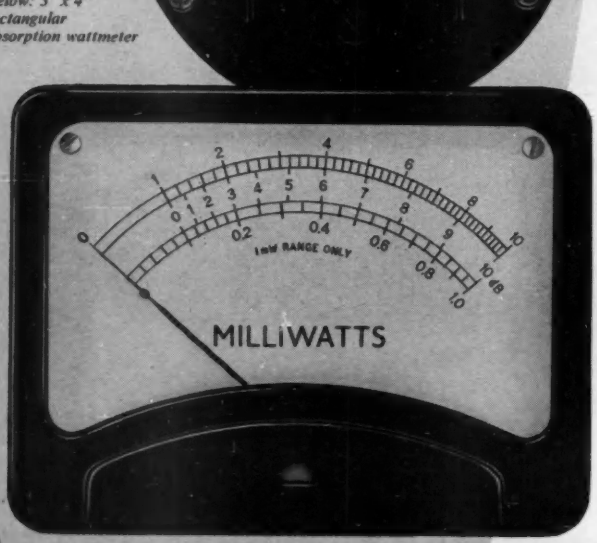


Above 2" square moving coil voltmeter



Right: 2½" round moving coil micro-ammeter

Below: 3" x 4" rectangular absorption wattmeter



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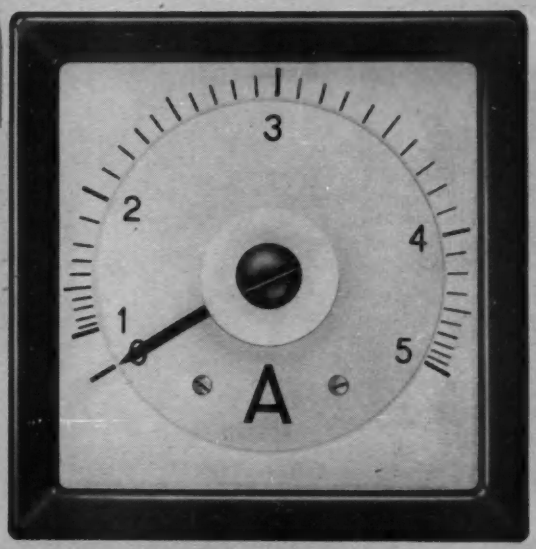
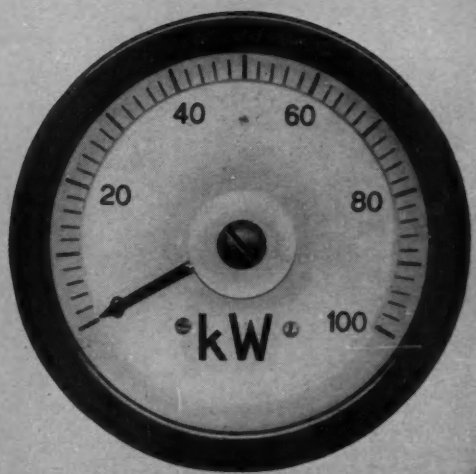


Above: 240° Scale Moving Iron Ammeter



Above: 240° Scale Dynamometer Wattmeter

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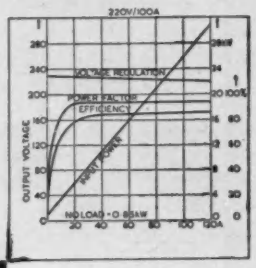

General characteristics of a typical Philips Rectifier can be seen from the graph above, showing a rectifier designed to operate from 3-phase supply and giving up to 100 amps at 220/230 volts DC.
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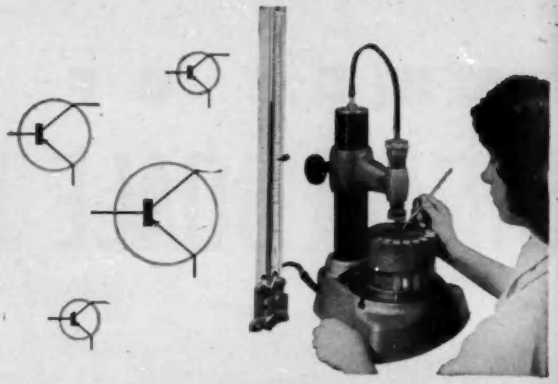

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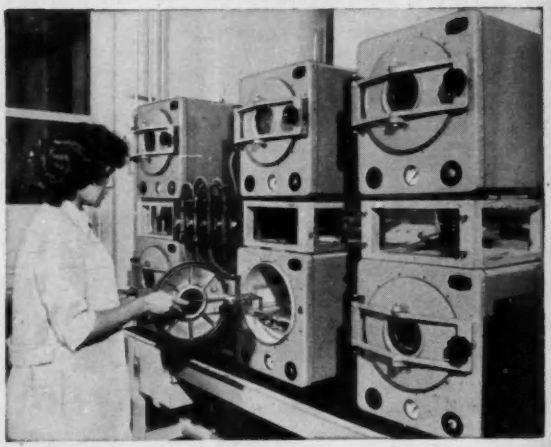
Above : Grading germanium wafers prior to assembling into transistors

Drying germanium wafers in vacuum ovens



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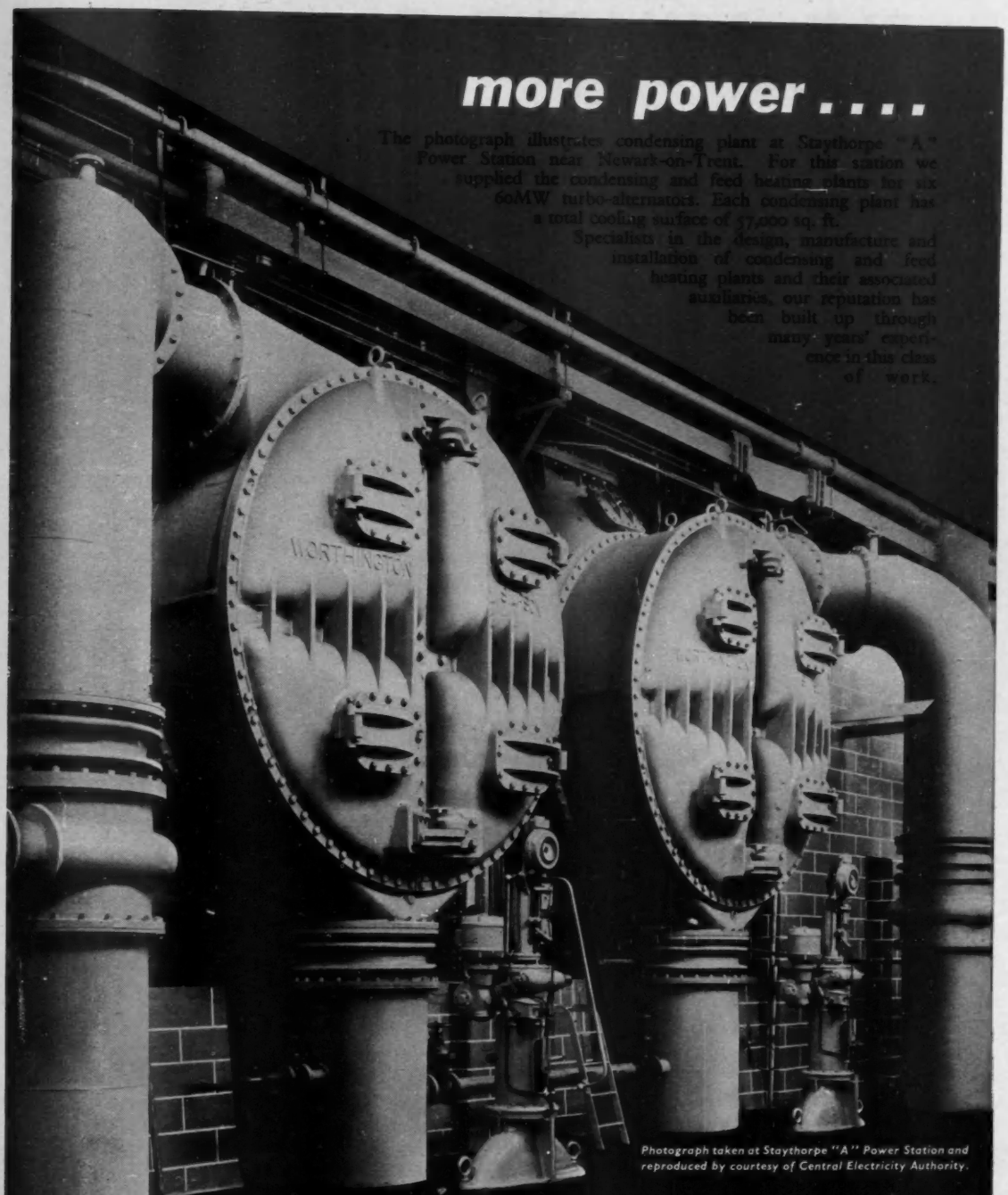

Photograph taken at Staythorpe "A" Power Station and reproduced by courtesy of Central Electricity Authority.

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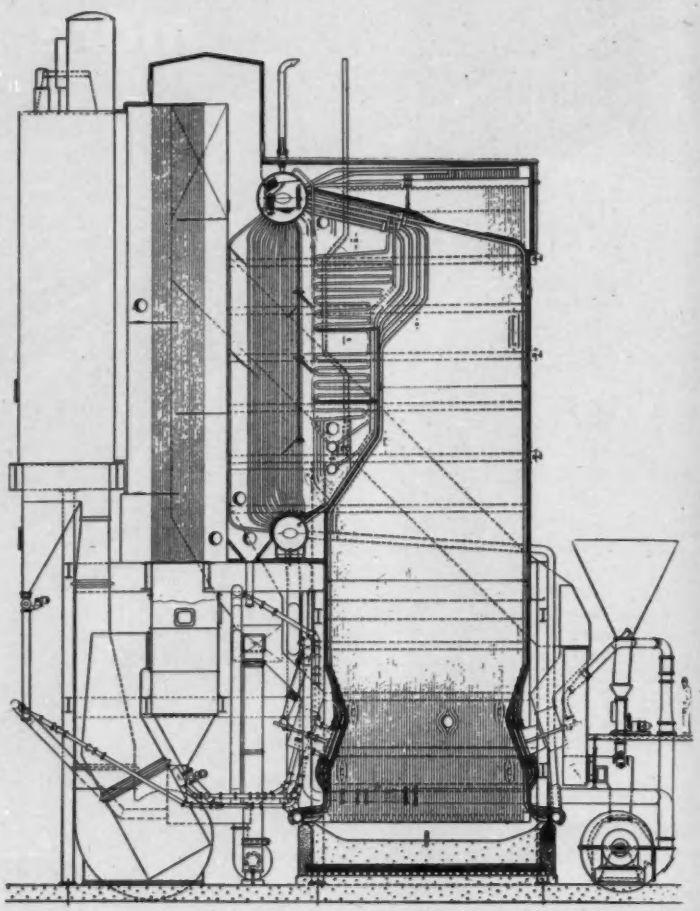

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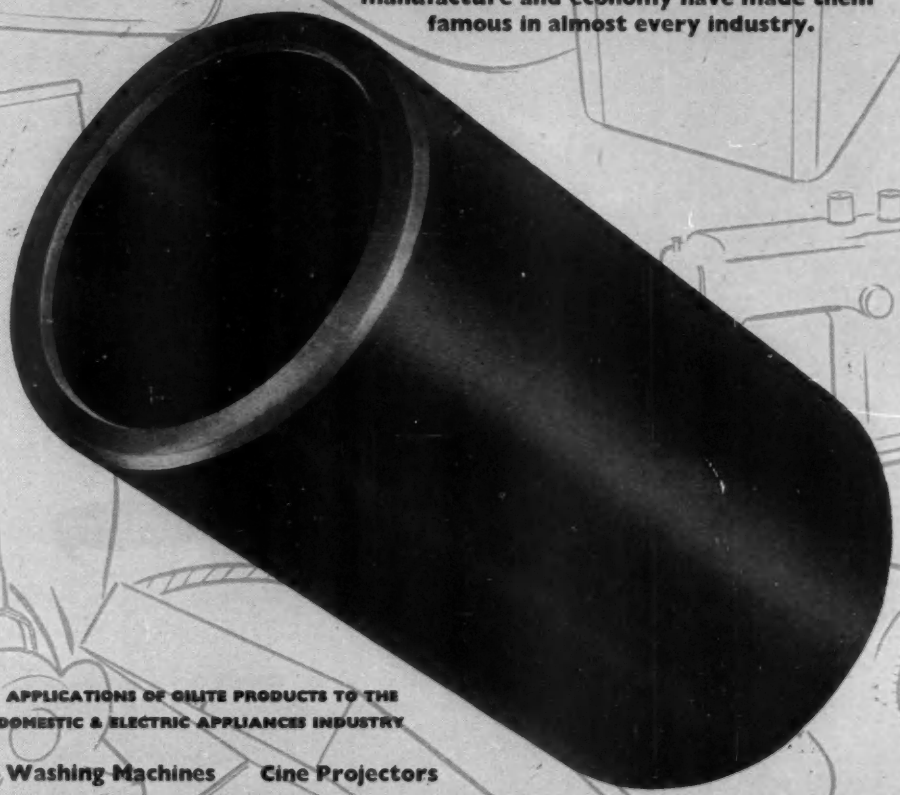

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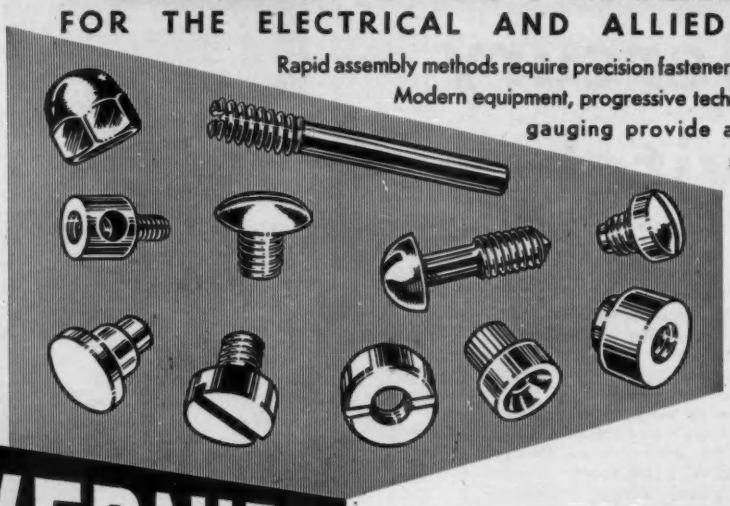

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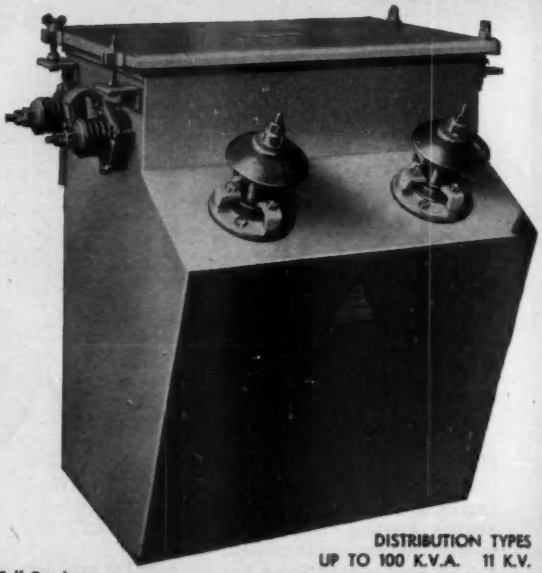

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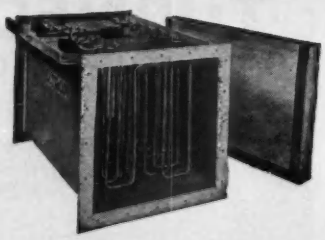

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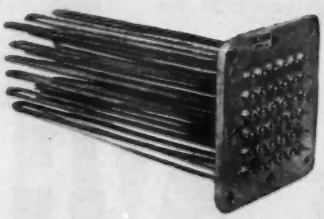

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CH36N

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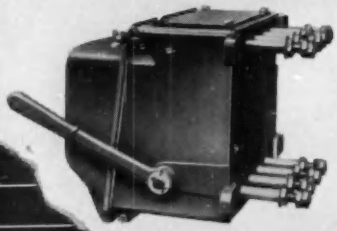

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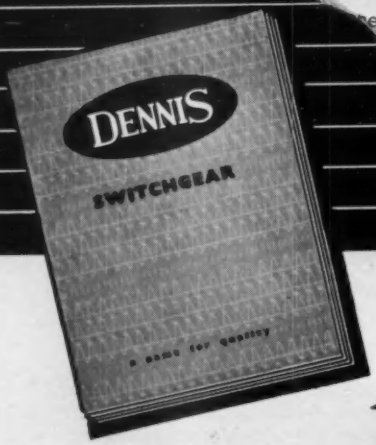

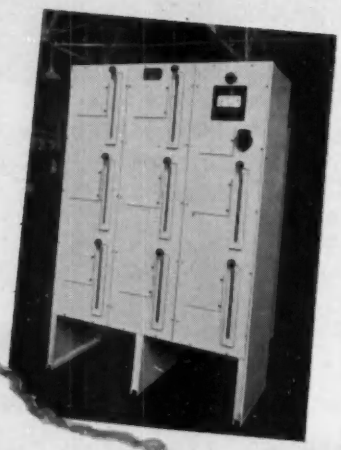

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11 APRIL
1958

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

In This Issue

Amplifying Nature	675	Besides the progress made in harnessing natural forces, scientific research has resulted in the production of new materials by synthesis, some aspects of which "almost suggest competition with nature itself." Plutonium is an outstanding example
Canadian Standards	677	The author describes a few Canadian electric power standards and common practices where they differ from those adopted in Great Britain, particularly in the transmission, distribution and domestic fields. Reference is made to motor, wire gauge and general standards
Crane Control	681	There are two main groups of electric crane control systems: a.c. and d.c. In the present article the author describes the currently available d.c. systems and deals with rheostatic control, variable voltage control, field control and the series-parallel method using two mechanically coupled motors
Underground Cable Laying	696	A review of the latest mechanised methods of laying underground cables in various types of ground with descriptions of apparatus developed specifically for these purposes
New Techniques in Industry	699	The I.E.A. exhibition which is broadly surveyed in this article is not merely of interest to workers in the scientific instrument field; it has an altogether wider appeal, not only in this country, but abroad. Indeed, British instrumentation makes a substantial contribution to the export market
Silicone Insulated Traction Motors	703	For some time now research work has been undertaken by London Transport to evaluate the suitability of silicone materials for the insulation of armature windings of traction motors. This article describes the work, which it is hoped will result in longer life, improved performance and economy in maintenance
Automatic Train Control	707	Contracts valued at over £500,000 have been placed for initial supplies of British Railways standard automatic train control apparatus. This is sufficient to equip 2,000 steam locomotives and most of the equipment is expected to be delivered this year. The article describes the equipment and mode of operation of the A.T.C. system

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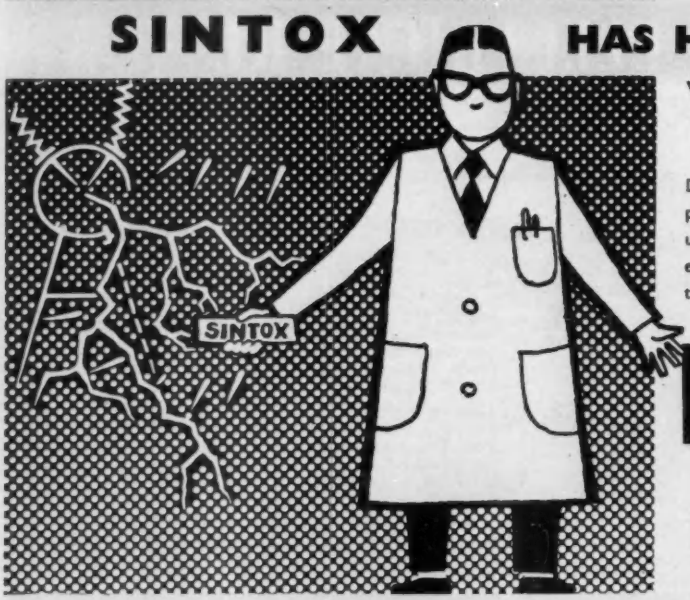

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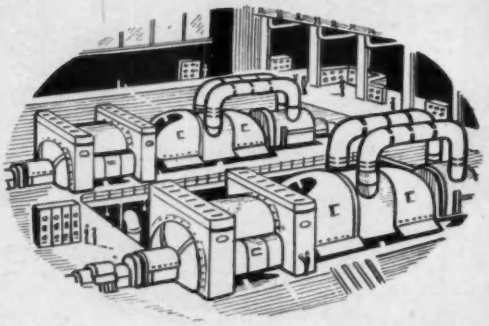

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ELECTRICAL REVIEW

11 April 1958 Vol. 162 No. 15 Established 1872

Amplifying Nature

WHILE energy in nature has a virtually limitless source in the sun, the proportion used to provide a minimum basis of civilised life is still pitifully small. Civilisation hardly existed before efforts to use energy efficiently for the most rewarding purposes took the place of a mere acceptance of what nature provided in the raw. Means were then devised, at first empirically and later from the store of technical knowledge built up by experience, to increase by many times what was previously done by human and animal labour, discoveries made in one branch of science often leading to advances in others.

A further development, while interwoven with the classic engineering aim of most efficiently applying natural resources, has been a more positive approach towards securing actual control of their inherent characteristics. That has come from research into the fundamental properties of various materials and combining them to produce synthetic materials to such an extent (and as far as practicable only to such an extent) as may be most suitable for specific purposes. An insight into the workings of this principle, especially in regard to dielectrics, could be gained from the Kelvin Lecture of Dr. H. W. Melville (reported in our issue of 14th February), in which he showed the effects of the artificial and logical rearrangement of large molecules of the polymer group.

An early example of a different kind was the association of the magnetic properties of iron with the high electrical conductivity of copper, which made practicable the large-scale generation of electricity and its transformation. More recently the alloying of steel with other elements has made possible the high steam temperatures that are reflected so remarkably in coal saving in electric power stations.

Some aspects of synthesis almost suggest competition with nature itself, as in the creation of the artificial element plutonium as the result of nuclear fission, and in the portent of ZETA, now well on the way towards rivalling the temperature of the sun's surface where nuclear fusion is continuous. Electrons also have been harnessed to secure "automation," with the aid of other scientific developments, and to make calculations with an accuracy and speed well beyond the range of the human brain, though the vital principle of personal initiative is absent. One more sidelight is the achievement of very high transmission voltages as an increasingly potent factor in compensating for inequalities of power resources in different regions; even now these

exceed the estimated potential difference between the upper atmosphere and earth during severe thunderstorms. Synthesis of energy manifestations in electrical engineering are of particular importance. Whereas the yearly increase in world consumption of energy as a whole is now about 2½ per cent, for electricity it is more nearly 8 per cent so that, assuming a continuation of the present trend, within the next twenty years half the energy used will be in an electrical form.

UNDERGROUND CABLES

The old view that relative cheapness provided the only justification for the use of overhead lines received early refutation more than 30 years ago when electrons became a nuisance in originating breakdowns of the dielectric of three-phase cables subject to daily load cycles at over 25 kV. This difficulty was cleared up and thereafter the reliability of cables kept pace with increasingly higher voltages, even though for technical and economic reasons they are ruled out for use at voltages normally used in main transmission over more than a few miles.

The margin between costs of underground and overhead secondary transmission up to, say, 33 kV tends to become narrowed in open country, where excavation and reinstatement of the ground now present less formidable problems. The development of mechanical trenchers, as described by Mr. J. E. Walker on page 696 of this issue, has strengthened the case for the use of 11 kV cables in such situations which was presented by the late Mr. P. V. Hunter in his presidential address to the Institution of Electrical Engineers in 1933.

CANADIAN ELECTRICAL PRACTICE

In view of the vast area of Canada and the great extremes of climate there, it is hardly surprising that there should be some variations in electrical practice from one Province to another. What is more to the point are the large differences between Canadian and British often obligatory codes. Fortunately the British Standards Institution is authorised to approve equipment here before export.

One notable difference in practice, as Mr. E. J. Robertson states in this issue, is the common use of banks of single-phase transformers for giving three-phase supplies. These are generally installed in Great Britain for this purpose only to obviate transport difficulties, the reliability of modern three-phase transformers having been found to justify abandoning the partial additional security in operation of three single-phase units connected in open-delta.

E.T.U. CLAIM REJECTED

Chaotic conditions might have ensued if the Electrical Trades Union had succeeded in a claim which the Industrial Disputes Tribunal has just rejected. It was, in essence, a proposal that, in certain circumstances, the rates of pay of journeymen electricians should be assessed in the light of conditions at individual sites. The claim was based on a contention that sometimes when site contractors' employees were working alongside electricians their pay, even if they were labourers, was higher than that of the skilled electricians. This was because of the existence of payment-by-results or incentive schemes in the building industry.

Thus, it was contended, the standard rate should be regarded as the minimum and additions should be negotiated on the site, according to the prevailing conditions. It is quite easy to see how this principle could be extended until almost every job would carry its own special rates. The National Working Rules for the Electrical Contracting Industry already provide for extra payments by employers to individual electricians of special ability, carrying responsibility, or with long service, or for work calling for "unusual physical ability." There is sufficient latitude here to enable those who merit it to be suitably rewarded.

THE BRUSSELS EXHIBITION

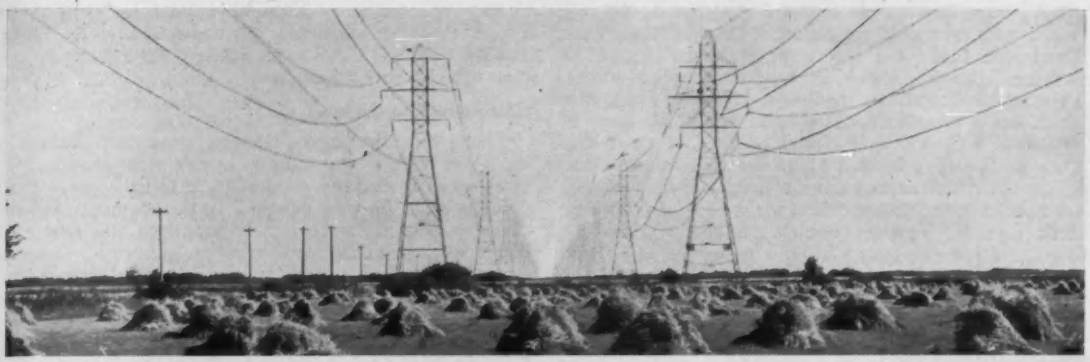
On Thursday next the Brussels Universal and International Exhibition is to be inaugurated by the King of the Belgians and it will remain open until 19th October. The Exhibition has been arranged on the grand scale and about fifty countries have contributed, some of them on most elaborate lines. As our readers have already been told, the British participation is of a dual character. The United Kingdom Government has been responsible for a Pavilion in which British traditions, culture and achievements are depicted, while the Federation of British Industries (through its subsidiary, British Overseas Fairs, Ltd.) is sponsoring the Industrial Pavilion.

The principal section of the latter Pavilion is that devoted to British electrical and allied machinery and equipment, but there are also displays by the United Kingdom Atomic Energy Authority, the Birmingham Exchange and Engineering Centre, and other organisations and individual companies. The Industrial Pavilion alone will warrant a visit to Brussels, but the whole Exhibition will be a memorable one and should not be missed.

SILICONE INSULATING MATERIALS

Since the end of the war great strides have been made in the development of silicone insulating materials, and in this issue we describe some work which is being conducted by London Transport in connection with traction motors. They point out that in most cases the failure of a traction motor arises from the thermal ageing of the insulation which leads to carbonisation and tracking. Silicone insulating materials have been found to possess a more stable chemical structure than mica and other organic insulants, and their decomposition, when it takes place, leaves no electrically conducting products. Furthermore, they can withstand elevated temperatures and are less liable to thermal ageing.

The use of these materials seems to offer substantial advantages in the general efficiency of traction motors and other machines with similar conditions of duty. Since silicone insulation can withstand high temperatures this would also permit of a reduction in the physical size of a machine for a given output by letting it run closer to the limit of its rating.



Canadian transmission lines

Canadian Standards

Review of Electric Power Practices in Canada

By E. J. ROBERTSON, B.Sc.Tech., A.M.I.E.E., M.E.I.C., M.Amer.I.E.E., P.Eng.

THE voltages used for transmission systems in Canada vary considerably according to load requirements, transmission distances, and other governing factors. Extra-high voltages (up to 345 kV) are required for operating transmission lines of great length. Densely populated or industrialised zones in and around the larger cities are fed with voltages up to 220 kV, although 110 kV, 60 kV and 12 kV, 60 c/s are more common for urban and suburban districts.

In the lower range of three-phase transmission and distribution voltages, those in common use include 13,200 V, delta three-wire; 6,900/12,000 V, star four-wire; 4,600/8,000 V, star four-wire; 4,600 V, delta three-wire; 2,400/4,160 V, star four-wire; 2,300 V, delta three-wire.

Transformer Connections

Three-phase transformers are rarely used; more often, three separate single-phase units are employed. These may be connected in any one of the accepted ways; delta-star or star-delta are very common for both step-up and step-down purposes. The h.v. transmission lines commonly feed the delta-connected primaries of the transformers which have their l.v. secondaries connected in star with an earthed neutral. This provides a supply particularly suitable for feeding an unbalanced four-wire service. The phase-to-neutral connections may feed numerous independent single-phase distribution transformers, each feeding its own load, and they are not interconnected.

Delta-delta connections are not uncommon, particularly in the lower range of voltages. Star-star may be used for interconnecting transmission lines of different voltages but is not normally used for distribution transformers, because of its inherent disadvantages, even with a solidly earthed neutral.

Not infrequently, two single-phase transformers are connected in open-delta in order to provide a three-phase supply. The capacity is only 57·7 per cent of that of three transformers, i.e. the internal power factor is 86·6 per cent with a load at unity power factor. Although this connection is primarily to meet emergency conditions, such as one transformer in a three-phase bank becoming unserviceable, there are occasions when it is justified to provide a three-phase supply to an existing small load where an increase is expected in the near future. The initial investment is thus cut substantially and a third transformer can be added to close the delta when conditions warrant it. Another example is where the load is seasonal and one transformer can be cut out for the greater portion of the year.

Consumer Voltages

There are several different secondary voltages supplied to consumers for industrial and domestic applications. At the lower end of the scale, 115-230 V is the standard supply in the home as well as to a large extent in industry. The standard for lighting is 115 V which is also used for small domestic appliances such as kettles, toasters and irons.

To provide this, single-phase distribution transformers have two secondary windings. They may be connected in series to give 230 V or in parallel for 115 V. Normally they are connected in series and the mid-point is earthed so as to provide 115 V from either outer to earth and 230 V between outers. The loadings on the two secondary windings are balanced as far as possible.

This is a very useful scheme as it has all the advantages of 230 V which may be used for small single-phase motors, electric cookers, water-heaters, etc., but also provides the standard 115 V for lighting and small appliance loads.

There is a considerable saving in copper compared with a straight two-wire 115 V system because the current per wire is halved. With the mid-point earthed, an earth fault on either of the outside wires blows the fuse. The neutral wire generally carries much less current than either of the outer wires unless the loading on the two sides is very unbalanced. For the internal wiring of buildings, the neutral wire is an identified conductor with no fuse and is large enough to carry comfortably any currents which will not blow the fuse in either of the live leads.

Domestic Circuits

Houses with only lighting and other small loads have a 115 V two-wire supply feeding into a 30 A switch-fuse whereas those with electric cookers and so on have a 115-

230 V, three-wire supply into a 60 or 100 A two-pole switch with overload protection. The usual domestic distribution board has several general purpose circuits carrying lighting fixtures or baseboard socket-outlets. They are wired with No. 14 Brown & Sharpe gauge wire which has a cross-sectional area of about the same as No. 16 S.W.G. and each circuit is fused at 15 A with screw-in plug-type fuses. There are also several small appliance circuits for the kitchen area each of which carries not more than two socket-outlets for the use of an electric kettle (1,500 W), a toaster (1,000 W), or an iron (1,200 W), to quote a few examples. These circuits are wired with No. 12 B. & S. (about No. 14 S.W.G.) and are protected with 20 A screw-in type fuses. There are also the individual circuits each providing a supply to only one appliance such as an electric cooker. The size of these latter conductors and fuses is governed by the load of the particular appliance served. Screw-in type fuses are permitted up to not more than 30 A. Above this rating, cartridge fuses are used.

Distribution Boards

Some distribution boards incorporate a combination of fuse-only and switch-and-fuse branches; others are of the no-fuse pattern as each circuit is protected by its own breaker having overload trip ratings of from 15 to 30 A. The main incoming switch may be located on the board, which itself takes two-, three- or four-wire mains, with two-wire branches incorporating a single plug-type fuse in the live leg of each branch and a solid neutral in the other leg which is earthed. In a 230 V circuit across the outers of a three-wire service, both legs are fused or have other overload protection. For circuits rated at over 30 A, cartridge fuses may also be provided on a board carrying plug-type fuses.

Fabricated sheet-metal cases enclosing distribution boards, splitter boxes, switches, starters and so on, invariably have " knockouts " for cable entries rather than conduit entries. A threaded bushing with a flange is used at the cable entry; a locknut on the other side of the sheet metal casing holds it in position before the cable is pulled in. Rubber and synthetic bushes and grommets are used where necessary.

Another common low voltage secondary supply is a 120-208 V four-wire service. That is, from three single-phase transformers with their secondaries connected in star to give 208 V between phases and 120 V between any phase and the star point. It is commonly used to provide a 208 V supply for small three-phase loads as well as the 120 V for the lighting and other single-phase circuits.

For industrial applications, 575-550 V is very common. It may be for feeding three-phase motors, for example, and is usually provided from the delta-connected secondaries of three single-phase transformers.

Canadian Standards

A standard reference for electrical practices is the Canadian Electrical Code issued by the Canadian Standards Association, C.S.A. Approvals Laboratories, 77, Florence Street, Toronto, 3, Ontario. Part I covers the essential requirements and minimum standards governing electrical installations in buildings. Part II covers specifications upon which the C.S.A. approval of electrical equipment is based.

For the benefit of electrical equipment manufacturers exporting to Canada, the B.S.I. acts as agent for the C.S.A. In 1952, it published a booklet as a guide to the British manufacturers and this has since been revised and enlarged to bring it up-to-date (PD 1533).

All electrical equipment for use in Canada must conform to the appropriate specification and display the C.S.A. approval number on or near the nameplate. The B.S.I., as agents for the C.S.A., can approve the equipment on their behalf before it is shipped.

Climatic Conditions

The factors affecting the choice of conductors and insulation are virtually the same as in any other country but the prevailing climatic conditions in Canada are rather different from those in Britain. In the southern parts of Canada, which are more densely populated, it is generally hotter in the summer and colder in the winter than in Britain. Canada has considerably more snow but it is a fine, dry powder which does not adhere to overhead lines as does the wet variety encountered in Great Britain. On the other hand, wet snow, sleet and freezing rain are also experienced in Canada and they adhere to everything.

Another consideration is that after a fall of snow, the temperature usually falls so that the snow does not melt and turn to slush but stays on the ground until it is removed or until the spring thaws begin. The frost, which is in the ground to a depth of some feet, stays for a month or so after the snow has disappeared.

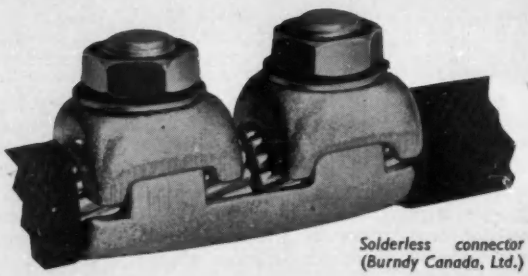
Canada has numerically more electric storms and more violent storms than commonly experienced in Britain. As most of the transmission and distribution is with overhead conductors, adequate lightning protection is of prime importance.

Overhead Conductors

In urban and suburban systems, wood poles with cross-arms are commonly used. Pole-mounted or platform-mounted transformers are abundant. Lattice type steel pylons usually carry the overhead h.v. transmission lines which are run as bare copper conductors whereas the distribution wires have a weatherproof insulation consisting of closely woven cotton braiding which has been impregnated with a tar compound. It has to withstand the ravages of exposure to the weather and must not crack at the low temperatures encountered (say minus 30 deg F even in southern Canada) nor melt at the higher summer temperatures of over 100 deg F in the shade. It has its merits where conductors may swing together in strong winds or be brought down to the ground by gales in populated areas.

Underground Cabling

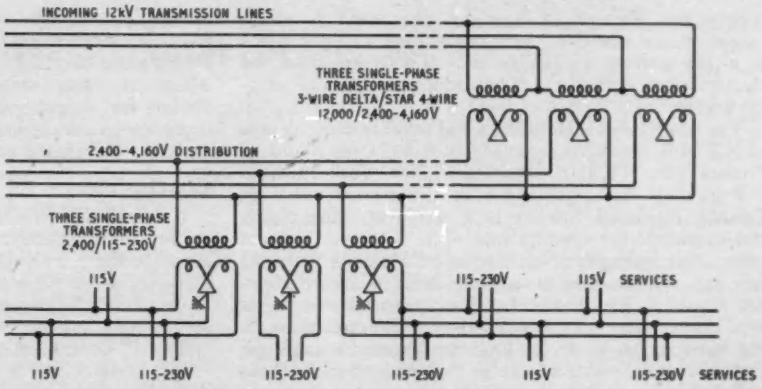
Buried cables may be laid direct in the ground at a depth of three feet or in ducting. Protection against mechanical damage in the form of 2in by 6in creosoted wood planks is provided for unarmoured cable in common backfill. Underground power cables in trenching usually have varnished cambric, rubber or paper insulation, and are lead-covered and jute served; they may or may not be steel tape armoured. Cables with " Neoprene " jackets, plastic covers and the like are also used quite extensively for direct burial. With the very low temperatures experienced



Solderless connector (Burndy Canada, Ltd.)

in the north, say minus 60 deg F, paper insulation may tend to become brittle and, in consequence, crack in the course of handling. For this reason, r.i.l.c.j. is the more favoured variety.

Power lines are not run underground nearly as much as in Britain. This is partly because of the substantial difference in cost, of course, but it is also partly due to weather conditions which virtually prohibit ground excavations in winter, not to mention the difficulty of plumbing joints, etc., in sub-zero (deg F) weather. Cables are rarely run underground simply to preserve the appearance of the district. There is usually a more practical reason such as their being a hazard to aircraft on or near an airport or because they would otherwise cause interference with radio communication facilities. When cable is too large and heavy for ordinary overhead suspension, messenger wire is used or else it is buried.



Schematic diagram of urban and suburban distribution systems

Solderless connectors are used very extensively for both light and heavy duties on high and low voltage circuits. They may take the form of sleeves or lugs which are screwed, clamped or indented to make a secure and efficient connection whether as a terminal lug, a straight-through joint or any of a variety of T-connectors as well as connections to busbars, ground-rods and the like.

Street Lighting

Street lighting is usually on its own separate circuit and the series constant current system is used. The transformer primary voltage is either 2,400 V or 4,160 V and the constant current either 6·6 A or 20 A. Systems may be either automatic or manual in operation.

Wire Gauge

As distinct from the British Standard Wire Gauge (S.W.G.) the standard sizes of conductors in Canada are quoted in Brown and Sharpe gauge (B. & S.) which is the same as the American Wire Gauge (A.W.G.). The B. & S. gauge covers sizes numbered 40 (the smallest) to 4/0 (0000), the latter has a diameter of 0·46in compared with 0·464in for No. 6/0 S.W.G. The diameter of No. 36 B. & S. is 0·005in which is in the range of Nos. 39 and 40 S.W.G. The intermediate B. & S. sizes are in geometric progression which can be extended to cover Nos. 38 and 40.

Conductor Sizes

Conductors larger than No. 4/0 B. & S. are specified by their respective cross-sectional areas expressed in circular mils, not in sq in. A circular mil is the area of a circle with a diameter of one mil (0·001in). Hence, the area of a solid wire in circ. mils is equal to the square of the diameter of the wire expressed in mils. For example, No. 4/0 B. & S. has a diameter of 0·460in; the square of 460 (the diameter in mils) is 211,600 which is the cross-sectional area in circ. mils. It is easy to remember that a circle one inch in diameter has an area of one million circ. mils (0·7854 sq in).

To convert circ. mils into sq in, divide by 1,273,200, thus the cross-sectional area of No. 4/0 B. & S. is 211,600 divided by 1,273,200, i.e. 0·1772 sq in.

The standard sizes of larger conductors are 250,000, 300,000, 350,000 and 400,000 circ. mils and thence in increments of 100,000 circ. mils up to 2,000,000 circ. mils. As these large numbers are rather cumbersome to quote, conductors larger than the B. & S. range are usually expressed in mega circular mils (MCM).

In order to memorise data on B. & S. copper conductor sizes, No. 10 B. & S. may be taken as a base. Its diameter is 0·10in; cross-section 10 MCM; resistance of 1,000ft at 20 deg C is approximately 1 ohm; the weight is 31·4 lb per 1,000ft. It may be easier to remember No. 2 B. & S. is very nearly 200 lb per 1,000ft. An increase of ten numbers in the B. & S. gauge size multiplies the weight and the cross-sectional area by ten and divides the resistance per unit length by ten and vice versa. An increase of three gauge numbers doubles the area and the weight of any given length and halves the resistance.

Current Ratings

The current-carrying capacities of the various standard sizes of conductor are tabulated in the Canadian Electrical Code as well as all relevant data such as the permissible number of conductors of a given size that may be installed in a conduit of specified dimensions. The ratings of fuses and settings of other overcurrent devices as well as the restrictions for the different classes of hazardous locations and many other pertinent features are all included in the Code.

Motors and Generators

Standards for motors and generators (a.c. and d.c.) follow those of the National Electrical Manufacturers' Association and are therefore known as N.E.M.A. machines. They were developed in the United States in 1929 and were consequently found to be under-rated in view of present-day developments. Revisions were therefore introduced a few years ago. More horsepower is now provided by the same frame size of motor and several new frame sizes were introduced. In Canada, they are correctly termed C.E.M.A. (Canadian Electrical Manufacturers' Association) and colloquially known as new-N.E.M.A. sizes.

Each of the standard enclosures such as protected, drip-proof, totally enclosed, etc., has several classified categories known respectively as Design "A," "B," "C" and so on according to their respective characteristics. For example, Design "B" is a general purpose motor with a low starting current, normal torque and normal slip. Design "A" has similar characteristics but a higher starting current, and in consequence is virtually

superseded. Design "C" on the other hand, is a high torque motor whereas "D" has a high slip and "F" is a low-starting torque motor. There are also the classifications of motors for hazardous locations of varying degree.

The respective characteristics and other relevant details of N.E.M.A. machines are available from Nema Standard Publications, 155, East 44th Street, New York 17, N.Y.

Regarding the construction of the motors made in Canada, the usual winding is a two-layer, three-phase, star-connected lap winding with open slots and diamond coils. For voltages which cannot be obtained with this winding, a single-layer three-phase delta-connected winding is used. The diamond coil with a mush winding is used much more extensively than in Europe, even on machines up to 30 or 40 h.p. In larger machines the Canadian practices are more in line with those adopted in Britain.

Since the standard frequency is 60 c/s, synchronous speeds of a.c. motors are in the series 450, 600, 720, 900, 1,200, 1,800 and 3,600 r.p.m.

Motor starters are of many different types of more or less conventional design. There is the full voltage (across-the-line) type which may be manual or magnetic and may incorporate the necessary safety features such as temperature overload control relays of the bimetal type. There are also auto-transformer starters, resistance starters for wound rotor motors, capacitor-start motors, repulsion-induction and so on, as well as load-measuring devices to eliminate automatic reclose on a short circuit.

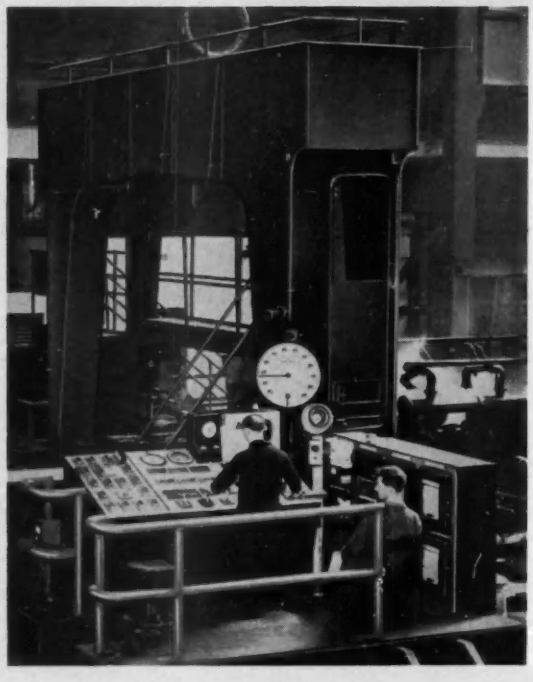
Conclusions

It is impossible to cover in this article more than a small portion of the electrical practices in Canada. Furthermore, in the permissible methods of providing a service, there are a few variations from one Province to another as well as regulations and restrictions imposed by the local supply undertaking which is usually referred to as the "Hydro" because of the predominance of hydro-electric supply companies. It is nevertheless felt that the foregoing has some academic interest as well as indicating some of the differences in basic technique with which the electrical engineer should become familiar if he is in any way connected with the supply of electrical equipment to Canada or if he plans to visit or practise in this vast Commonwealth territory, which is developing so rapidly.

Steel Strip Width Gauge

A SERVO driven optical arrangement for the monitoring of deviations in width of hot steel strip in a continuous mill has been developed by Evershed & Vignoles, Ltd., from a system initiated by the British Iron and Steel Research Association. The system relies upon the natural radiation of infra-red rays from the strip, and is sufficiently sensitive to respond to material that has cooled to a very dull red. Two edge followers are used, each of which tracks the individual motions of the edges, the combined readings being summated electrically to give a signal proportional to the deviation in total width.

Evershed hot strip mill measuring gauge



The edge followers are mounted upon a traverse which straddles the mill a few feet above the run of strip, and are motorised so that the two may be spaced apart to a distance equal to the nominal width of strip being produced.

The method of detecting and tracing the change in edge position compensates for variations that may arise in signal strength due to fluctuations in the rolling temperature. Radiation from the surface of the strip is projected through a lens and prism on to two photocells, placed side by side. One of the cells receives a constant amount of energy from a section of strip inboard of the edge, whilst the other is activated by the edge itself. Movement of the edge increases or decreases the radiation upon this cell dependent upon the direction in which the strip moves. A shutter is driven across the face of the other photocell, reducing the energy upon it to a value equal to that obtained by its neighbour. This system of balancing radiation ensures freedom from temperature effects and compensates for changes in the cell characteristic due to ageing.

The photo-electric sensing device presents a "chopped" signal to a built-in 50 c/s amplifier, the output of which drives the shutter mechanism by means of a small a.c. servo motor. Adjustable damping is provided by means of tacho-feedback derived from a small generator attached to the end of the motor. The unit operates on a 50 V single-phase supply.

For a wide strip mill, the followers are mounted on a special gantry above a foot bridge. The traverse consists of two motor driven lead screws enclosed in an oil-filled trunk upon which the two followers slide. The ½ h.p. motor is mounted at one end, and at the other end a shaft extension is coupled by a system of bevel gearing to an indicator for the setting of nominal width. This indicator is purely a mechanical arrangement of two pointers and dials and is calibrated to read over the whole range of widths to the nearest 1/32in.

A small panel mounting a roll chart recorder is used for the continuous recording of nominal width and deviation up to 3in. A similar remote indicator is mounted on the top of the finishing operator's control desk, which also contains the nest of push-buttons for control of the traverse motor. Cooling of the apparatus mounted above the mill is necessary and for this purpose a supply of water must be provided. The accuracy of the width gauge is ± 1/16in.

Electric Crane Control

I.—DIRECT CURRENT SYSTEMS

By H. H. BROUGHTON,

M.I.C.E., M.I.Mech.E., M.I.E.E.

IN the early stages of its development the electric crane was driven by a single d.c. motor and the several motions were operated either by a multiplicity of clutches or by open and crossed belts in a manner familiar to the millwrights. Low-angle "irreversible" worm gear was relied upon for the safe lowering of the load suspended from the hook, and the motor control gear consisted of a simple form of non-reversing starter in conjunction with a double-pole fuse and isolating switch. Some of these cranes are still in operation after 60 years' service, and in a number of instances the drive has been modified by substituting an a.c. induction motor for the original open-type d.c. machine.

The next stage consisted in using a separate d.c. series-wound motor for each motion, the speed and direction of rotation being regulated by means of a manually-operated drum controller. This paved the way for striking simplification of the mechanism, and difficulties during lowering were partially solved by introducing a mechanical (load) brake so arranged as to be inoperative

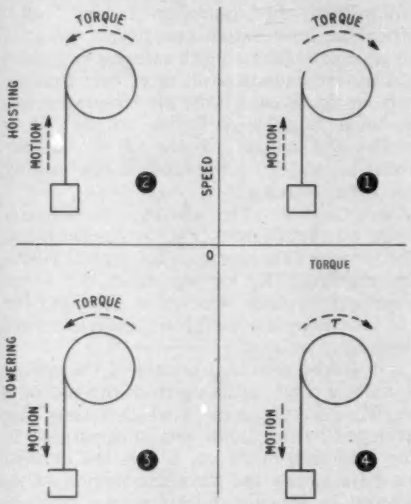


Fig. 1

during hoisting. Subsequently, the use of the mechanical retarding brake was discontinued in favour of electric braking. This innovation enabled the lowering speed to be greatly reduced before the holding brake was brought into action to stop the motion. The variable-speed characteristic of the d.c. series motor, and the control gear designed to take full advantage of such characteristics, established a high standard of performance. Owing to the availability of low-voltage d.c. supplies and to the introduction of satisfactory methods of d.c. rheostatic control, the application of the variable-voltage d.c. system was restricted to special types of cranes.

Apart from the substitution of contactor control for drum control, chiefly on account of increased sizes of equipment and ease of manipulation, the next stage in the development was the adoption of constant-speed a.c. induction motors which was deemed to be advisable in view of the world-wide use of three-phase a.c. power transmission. Initially, rotor-resistance controllers were used for all motions and mechanical load brakes were fitted for retarding the lowering speed. This meant that, as regards braking, the early a.c. drive was on a par with a discarded type of d.c. drive and inferior to the latter owing to the constant-speed characteristic of the induction motor. In recent years the crane trade has been faced with the difficult problem of modifying the characteristics of the constant-speed a.c. motor to obtain performance comparable to that of the variable-speed d.c. machine. This work is still in progress and partial success has been achieved in a number of instances by sacrificing simplicity of electric circuits.

The twofold purpose of this article is that of indicating the principal d.c. control systems, described above as having established a high standard of performance, and of noting some of the alternative a.c. systems which are available, or are in course of development, and which are intended to give characteristics comparable to d.c. systems.

The fundamental principles underlying motor operation are discussed in electrical textbooks, and the basic equations relating to d.c. and a.c. control circuits are dealt with authoritatively in several treatises. Accordingly, it will be assumed that the reader is versed in such matters. Control characteristics deduced therefrom give clear indication as to their suitability for a particular duty, and are furnished by the specialist firms in the form of graphs connecting speed and torque.

When performance curves are plotted, as shown in Fig. 1, the two axes intersecting at o fix four quadrants in one or more of which the speed-torque relation is depicted. Thus, when both speed and torque are positive, as in hoisting a load, the top right-hand section of the diagram, known as Quadrant 1, is used. In the top left-hand section, Quadrant 2, speed is positive and torque is negative, which means that the torque opposes, and therefore brakes, the motion. The bottom left-hand section, Quadrant 3, shows negative torque and speed or, for the motion under consideration, the crane hook is being driven in a downward direction by the motor. Finally, in Quadrant 4 speed is negative and torque is positive; hence motion of the overhauling load is opposed by electric braking action. In investigating the principal methods of control applicable to cranes such graphs will be used, and the associated schematic circuit diagrams are thought to be preferable to the actual diagrams of controller connections with which we are not concerned.

The desirable characteristics of a hoisting controller are: (*a*) hoisting normal loads at low, medium and high speeds; (*b*) hoisting light loads at low and high speeds; (*c*) lowering all loads at low, medium and high speeds; (*d*) provision of a creeping lowering speed throughout the normal range of loads; (*e*) lowering a non-overhauling load either at high speed or low speed; (*f*) prevention of excessive heating of the motor under all working conditions; and (*g*) easy testing and servicing of the controller and its accessories.

Requirement (*g*) implies main and control circuits with

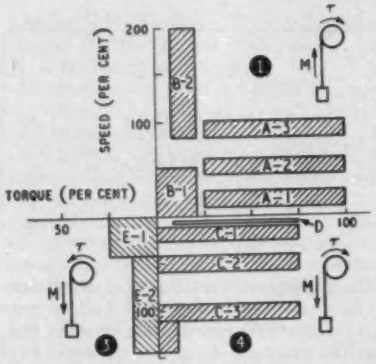


Fig. 2

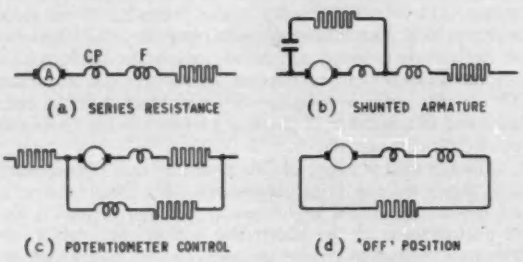


Fig. 3

which those responsible for maintenance are familiar, and applies equally to all systems of crane control. Of the above items (*a*) to (*e*) are shown as shaded areas in Fig. 2, which is a modified form of a diagram proposed by Risler. For ease of identification the areas lettered A—1, A—2 and A—3 refer to (*a*), and similarly (*b*) to (*e*). It will be seen that operation is required in Quadrants 1, 3 and 4. Superimposing a scaled copy of this diagram on the characteristics of the d.c. or a.c. controller it is proposed to use clearly reveals any departures from ideal performance.

D.C. Control Systems

The four ways in which the speed of a d.c. motor can be regulated are: (1) rheostatic control by varying the resistance in the armature and/or field circuits; (2) voltage control by varying the voltage across the armature; (3) field control by varying the strength of the magnetic field; and (4) by changing the number of turns in series on the armatures.

Rheostatic control, in a number of forms, is applicable to all crane motions. Voltage control is used for intensively operated motions and in cases where precision is required under widely varying loads and speeds. Field control, in conjunction with rheostatic control, is used for obtaining stable low speeds and is combined with voltage control when high speeds under reduced loads are necessary. Series-parallel connection of two motors, which enables the armature turns to be varied in a 2 to 1 ratio, is confined chiefly to traction and has a limited application to the travelling motions of heavy cranes and to the slewing motions of fitting-out cranes.

Rheostatic Control

The principal circuits are shown schematically in Fig. 3. Of these, the circuit (*a*) is referred to as series resistance control and is common to all rheostatic methods of control.

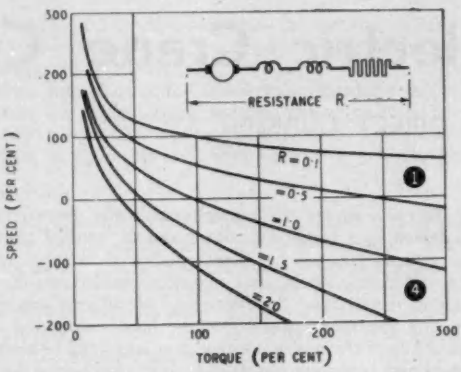


Fig. 4

Modified as shown in (*b*) by connecting a resistance across the armature, the circuit is known as shunted-armature or divertor control and is adopted when creeping speeds are required. When there is no likelihood of no-load operation of the motion, the shunt resistance may be connected across the motor terminals instead of across the armature. In lowering a load, torque which assists the motion of a lightly-loaded crane hook and retards the motion of a heavily-loaded hook, has to be developed and the two conditions are satisfied by means of the circuit (*c*). This is known as potentiometer dynamic braking control. With the controller in the "off" position, or when the limit switch operates, a dynamic braking circuit (*d*) is established which safeguards against overspeeding of an overhauling load, or of over-running the limit switch, in the event of the electro-mechanical holding brake being sluggish or failing to act. In a hoisting controller the several circuits (*a*) to (*d*) are combined, circuits (*a*) and (*b*) being used on the hoisting side, and circuit (*c*) for lowering.

Series Resistance Control. The schematic connections are superimposed on the diagram, Fig. 4, on which are plotted the speed-torque characteristics for several values of total series resistance R, varying from 0·1 to 2, expressed on the unit system. Curves of this kind for a wide range of resistances are useful in checking control systems and stepping of resistors.

From Fig. 4 it will be seen that certain of the speed-torque curves, namely those resulting from the use of a high resistance, R, enter Quadrant 4 which means that the torque developed by the motor acts in opposition to the overhauling load and, therefore, brakes the motion. Thus, a motor driving, say, the travelling motion of an overhead crane can be brought quickly to rest by connecting it to run in the reverse direction while still running in a forward direction. This operation, known as "plugging," results in the line voltage and counter e.m.f. of the motor armature acting in concert instead of opposition, and to limit the current additional resistance has to be inserted in circuit. Provided that the motor is suitably rated, and conditional on the resistors being correctly proportioned, plugging can be used with confidence for arresting travelling and similar motions possessing high inertia.

Series resistance control characteristics, and corresponding circuit resistances of a controller having one plugging contactor and four accelerating contactors, are given in Fig. 5 for forward operation. When a d.c. series motor is used the ultimate speed attained depends on the frictional resistances of the drive and on the distance travelled since the motion was started. If the motor

reaches rated speed, i.e. unity, and is plugged at this point, Curve 1 shows that the torque developed is 1·32 which becomes 1·83 for a speed of 1·4. Both are satisfactory when plain bearings are used, but with roller bearings higher overspeeds are to be expected unless the gear ratio is selected to suit the drive. Hence, a higher value of plugging resistor is desirable for such cranes and its effect is shown by the broken-line curve, 1A. From this it will be seen that the starting torque on point 1 is reduced from 0·52 to 0·36; the plugging torque at a speed of 1 becomes 0·93, and at a speed of 1·5 the plugging torque is 1·4. These values are said to give good braking without slipping the wheels.

Shunted-Armature Control. This method, also known as divertor control, is applied when service conditions are such as to necessitate one or more creeping speeds for accurate spotting of the load, for slowing down and for reducing shock. Combined with series resistance control the method is used for the hoisting motions of foundry, erecting shop and wharf cranes, and is often advantageously applied to other motions.

If the four resistances R_1, R_2, r_1 and r_2, Fig. 6 (*a*), are known or assumed, the armature current I_a and counter e.m.f. can be computed from the basic equations for several assumed values of field current I_f, and from these the corresponding torques and speeds are deduced. Fig. 6 (*b*) depicts the speed-torque characteristics for two values of armature shunt R_d and with a constant series resistance R_s in circuit. On the same diagram is given the performance curve without armature shunt. It should be noted that, in practice, site adjustment of the shunting resistor may be necessary.

Referring to Fig. 6 (*a*) the contactor C prevents the shunt circuit being re-made when the controller is moved from one of the high-speed notches to the "off" position. If in these circumstances the shunting resistance were inserted in circuit, the armature running at a high speed in a strong magnetic field would be short-circuited by a resistance of low value, and this would give rise to severe sparking at the commutator and excessive braking of the motion. With the controller in the "off" position the armature shunt circuit is re-established in readiness for the next start.

To obtain a low hoisting speed on the first notch of the controller throughout the load range a combination of armature and motor shunts may be used. Its effect is to minimise the change of motor terminal voltage and excitation with changes in load.

Potentiometer Lowering. Shown schematically in Fig. 7 (*a*), this method of control is outstanding and is now generally used in preference to other methods of electrical and mechanical (load) braking. The three resistors R_1, R_r and R_f, which are variable by means of the controller, determine the speed-torque characteristic of the drive.

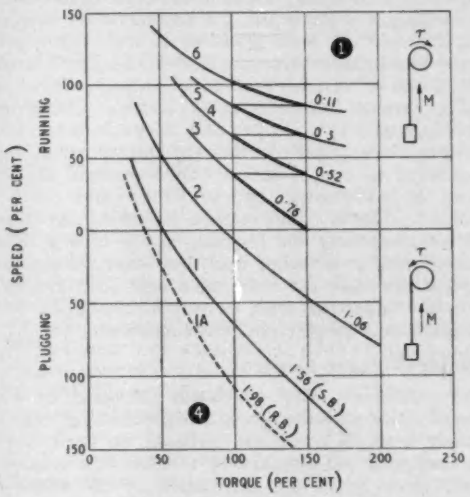


Fig. 5

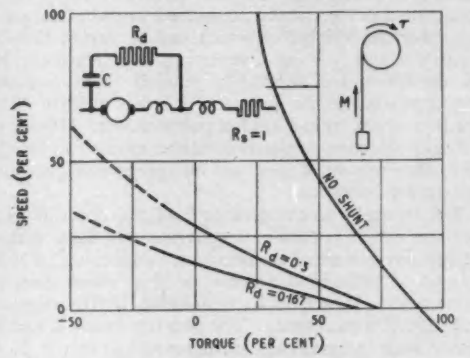


Fig. 6

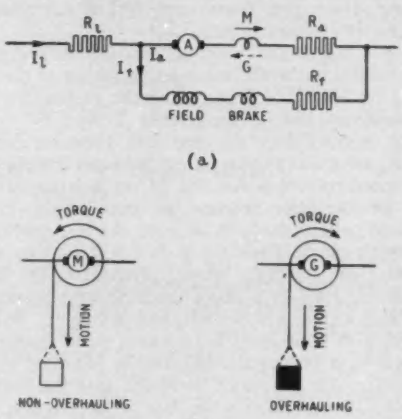


Fig. 7

When a load is being lowered the two torque conditions are those resulting from (i) a light load suspended from the crane hook; and (ii) a heavy load suspended. Both conditions are illustrated in Fig. 7 (*b*). To lower a non-overhauling load the motor torque assists the motion and the load is driven down under power at a controlled speed. To prevent overspeeding of a heavy load the torque developed by the machine must oppose the overhauling torque due to the load which means that the machine operates as a generator and acts as an electric brake. Corresponding to the two cases are the elementary electromagnetic diagrams, Fig. 7 (*c*), in which accepted notation is used. Under the action of light loads operation is in Quadrant 3 of Fig. 7 (*d*), whereas with heavy loads operation is in Quadrant 4. On any lowering notch of the controller the working point on the speed-torque curve, either as a motor or as an electric braking generator, is determined by the load on the crane hook.

Having given the magnetisation curve of the motor, the speed-torque relation is derived from the basic equations of the circuit by assigning common-practice values to the several resistors. For instance, expressed on the unit system, resistors $R_l=1$, $R_a=0{\cdot}33$ and $R_f=0{\cdot}31$ give the characteristic Fig. 7 (*d*). The determination of the operating characteristics for the several "lowering" notches of a controller is simplified by using linear graphs connecting counter e.m.f. and field and armature currents respectively. It is instructive to study the effect of maintaining at constant values any two of the resistors and varying the third resistor.

Depending on the control characteristics required, wide variations occur in the value and stepping of the resistors. For a typical hoisting controller the resistances in circuit on the several notches are given in Table 1.

For normal duty the line and armature resistors R_l and R_a are usually constant on the early lowering notches and speed control is effected by varying the field resistor R_f. On the later notches the line resistor R_l is often reduced progressively to zero on the last notch. Simultaneously the field resistor R_f is increased step-by-step to increase the lowering speed. Hence on the last notch the motor runs as a shunt machine with weakened field and with high armature resistance in circuit. When rapid lowering of light loads is required, extra resistance, controlled by a polarised relay, can be inserted in the field circuit on the last notch provided that the hook load is not excessive. Should the load be too heavy, the relay cuts out this resistance and reduces the speed to a safe value. Standard potentiometer controllers having four or five accelerating notches usually give maximum lowering speeds of 130 per cent with light hook and 165 with full load, but in certain cases high-speed lowering up to about 250 per cent with light loads can be obtained.

Performance curves of a controller with potentiometer connections on the lowering side are plotted in Quadrants 3 and 4, Fig. 8, and to complete the diagram the curves for the hoisting side, including one divertor-control notch, are shown in Quadrant 1.

Dynamic Braking in "Off" Position. In the case of an overhauling load, when the controller is returned to the "off" position it is necessary to establish a dynamic braking circuit so as to assist the mechanical (holding) brake in bringing the load to rest, and to prevent running down of the load at high speed in the event of maladjustment or failure of the brake. It also serves for stopping in an emergency. Such a circuit is shown in Fig. 9. When driven by an overhauling load the machine becomes a self-excited series generator and speed-torque curves are given for external resistances of 0·15 and 0·4. Thus, with a resistance of 0·15 or 15 per cent in circuit, if the overhauling torque is 50 per cent then the corresponding speed is restricted to 20 per cent. "Off" position dynamic braking is represented by the broken-line curve in Quadrant 4, Fig. 8. This method of braking can also be used for controlling the lowering speed of a grabbing crane, or other overhauling load, but when driving-down torque is necessary for lowering a light load the series generator connection must be supplemented by other methods such as the potentiometer connection.

TABLE I.—HOISTING CONTROLLER RESISTOR STEPPING

Notch	Hoisting		Off	Lowering		
	R_l	R_d	R	R_l	R_a	R_f
0			0·30			
1	0·95	0·166		1·05	0·30	0
2	0·95	0·30		1·05	0·30	0·09
3	0·95	—		1·05	0·30	0·24
4	0·52	—		1·05	0·30	0·52
5	0·24	—		1·05	0·30	0·95
6	0·09	—		0·58	0·30	1·42
7	—	—		0	0·30	2·00

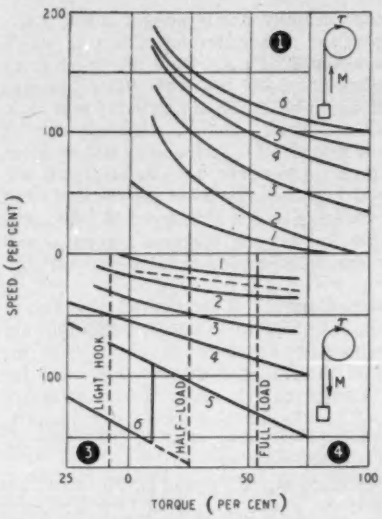


Fig. 8

Variable-Voltage Control

This system of control, which was introduced by Ward Leonard about 60 years ago, is being increasingly applied to many types of crane and is based on the fact that both the speed and direction of rotation of a constantly excited shunt motor are determined by the magnitude and polarity of the applied voltage. Referring to the schematic diagram, Fig. 10, the armature of the motor to be controlled is electrically connected to the armature of a generator the voltage of which can be varied between the limits 0 and $\pm$V by a reversing field regulator RS. Both machines are separately excited from constant-voltage busbars and the generator is independently driven at constant speed by any kind of prime mover. Hence the speed and direction of rotation of the motor can be controlled efficiently since there are no appreciable rheostatic losses during operation.

When driven by an overhauling load the motor becomes a dynamo which results in regenerative braking without changing any electrical connections. Moreover, if when the motor is running at normal speed in either direction the excitation of its field F_1 is reduced, by the regulator R_1, the speed is increased. The two regulators R and R_1, together with the generator field reversing switch S, are actuated by a drum controller, or master switch, with

contacts arranged so that the resistor R in the generator field is reduced step-by-step before the resistor R_1, in the motor field circuit, is inserted progressively. The field resistors R and R_1 are graded so as to give speeds approximately proportional to the displacement of the control lever.

Typical performance curves when motoring and generating are plotted in Fig. 11 from which it will be seen that seven of the control points are used for varying the generator field excitation and six points for weakening the motor field.

The arrangement of reversing field regulator shown in Fig. 10, combined with a motor field rheostat, gives a satisfactory control system for a general purpose crane. Refinements are necessary to facilitate operation of excavators, draglines and heavy duty grabbing cranes all of which are intensively operated on cycles of short duration.

Practically any speed-torque characteristic can be obtained by varying the excitation of the generator and/or motor fields. Amongst the ways in which the variation can be made are the following:—(1) By providing a number of field windings on the generator; (2) by means of a separate regulating exciter for the generator field; and (3) by so regulating the generator- and motor-field excitation that the former is decreased when the latter is increased. Each of these has been fully described in the engineering journals, and references are given in the bibliography attached to the second part of this article.

Apart from elimination of rheostatic losses during starting and a wide range of operating speeds, an important advantage of the variable-voltage system is that a substantial reduction in weight can be secured by operating the motors at a higher voltage than normal. Thus a certain 230 V motor has a rated output of 150 h.p. at 410 r.p.m., but when operated at 365 V the output is 250 h.p. which coincides with that of the next frame size supplied at 230 V, and the use of the smaller frame results in a saving in weight of approximately one ton.

In recent years variable-voltage control systems embodying automatic speed, current and torque regulation as inherent features have been used for man-trolley ore unloaders designed to work on a 60-sec cycle. In some of these installations provision is made for simultaneous variable-voltage operation of all motions and in others rheostatic control is retained for the bridge drive, apron hoist, turntable and ancillaries. It is probably too early to expect uniformity, but a satisfactory solution would appear to be to restrict variable-voltage control to the holding, closing and traversing motors with the motor-generator set and regulating exciters located on the bridge. This minimises the number of current collector bars that span the bridge, and effects a reduction in the weight of the man-trolley. The latter is important because, for a trolley of given weight, increased grab capacity takes the place of the heavy contactor control gear and associated resistors suspended from the trolley.

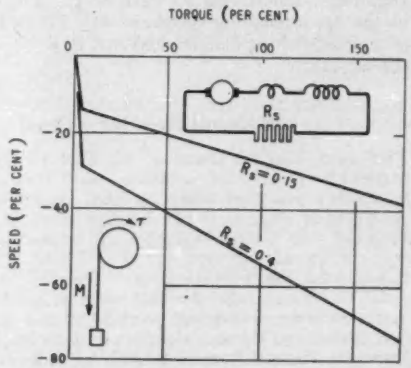


Fig. 9

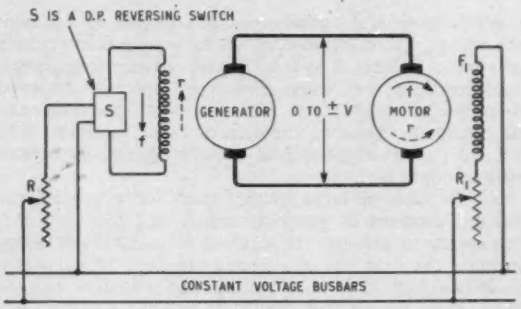


Fig. 10

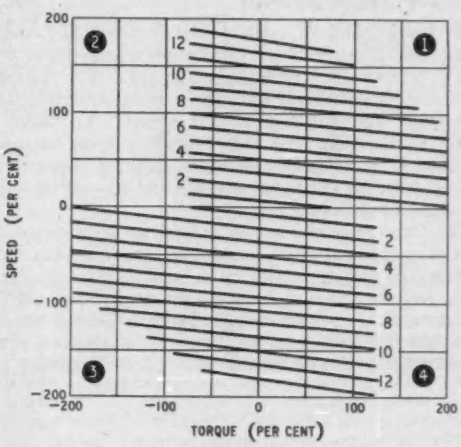


Fig. 11

Reference should now be made to a system in which the speed of the prime mover is changed, and which enables several motions to be operated simultaneously from a single generator without using resistors or relays. The mobile crane owes much of its success to the ease of operation resulting from this method. The several motors are controlled by means of contactor-type selectors, and speed variation is effected by the accelerator pedal of the engine. Should it be necessary to activate an additional motor while one motor is already running, the pedal is temporarily released after which the further motor is switched-in by the appropriate selector and the engine again accelerated. The generator has a characteristic which ensures rapid build-up of voltage at low speeds and provides automatic overload protection. A crane designed to lift 1½ tons at 29ft radius has a generator rated at 11 kW, 230 V at 1,800 r.p.m. on a 30 min basis, and the motor ratings are: hoisting, 12 h.p.; derricking, 6 h.p.; slewing, 2 h.p.; and travelling, 12 h.p.

Field Control

In dealing with rheostatic control it was indicated that field strengthening resulting from the shunted-armature connection furnishes reduced speeds for a given torque; also that progressive field weakening is used with the

potentiometer and variable-voltage systems to augment the speed. Speed increase by weakening the field strength of a motor is limited by mechanical and electro-magnetic considerations; but, when motors are specially designed to counteract both effects, high speed-increase ratios can be obtained. Used to supplement other methods, field control enables the required speed range to be secured with standard motors.

In the case of large motors used for operating the hoisting motions of grabbing cranes and the like, it is customary to arrange the control in such a way as to increase the field strength during starting. This, which is known as field forcing, reduces the armature current for a given torque and results in reduced heating since the latter is proportional to the square of the current.

Series-Parallel Control

In this method of control two mechanically-coupled motors are used which, at starting, are connected in series with a variable series resistance in circuit. The resistance is reduced progressively until the motors are direct across the supply and running at half speed. To make the parallel connection, after rearrangement of the circuits by the controller, resistance is again inserted and cut out, step-by-step, till the motors in parallel across the supply are running at full speed.

The three principal advantages of the method are: (*a*) for a given current input double the torque is obtained at starting; (*b*) motors connected in series across the supply run at half the speed of motors connected in parallel; and (*c*) economical use of energy during starting, the loss being half that with ordinary control. The more frequent the starting, or the higher the proportion of starting time to running time, the more important is the minimising of losses.

Rapid Lowering

Heat treatment of long tubes, shaft forgings and the like necessitates rapid constant-speed end-on lowering into the vertical oil-quenching tanks, sensitive control and reliable braking. The onerous duty is that of safely lowering heavy loads at controlled speeds which may be 10 to 20 times greater than the full-load hoisting speed, and of retarding the motion at a rate of 6 to 8ft per sec per sec. For such high speeds electro-hydraulic operation of the motion, both for lifting and lowering, is probably the best solution. A drive of this kind consists of two hydraulic jiggers operated by electrically-driven high-pressure pumps. These jiggers take the place of the usual winding drum, and lowering is effected by means of a valve arranged so as to control the rate of discharge of the fluid from the hydraulic cylinders. Data relating to a motion of this kind are:—

Hoisting	150 tons at 10 ft/min 75 tons at 20 ft/min	Two 100 h.p. 340 r.p.m. motors
Lowering	75 tons at 300 ft/min	

In another type of drive for similar duty the hoisting motor, coupled to the sun wheel of a planetary gear, is held at rest when lowering is in progress and the speed is regulated by a control motor which acts on the lowering brake. The load is free to accelerate until the speed set by the control motor is attained and, thereafter, the load itself controls the braking. Drives of this kind have been used for loads up to 300 tons, and with lowering speeds up to 260 ft per min. Although severe while it persists braking is not excessive when reckoned over a long period.

BRITISH LIGHTING COUNCIL

Regional Offices Established

WE reported in our issue of 8th November last the formation of the British Lighting Council by the British Electrical Development Association, the Electric Lamp Industry Council and the Lighting Equipment Development Council. (The last two organisations represent the lamp manufacturers and the lighting fittings makers respectively.) The purpose of the British Lighting Council is to continue and expand the work of the Lighting Service Bureau " to promote the full and proper use of light in the service of the community."

In pursuance of its aims the Council has set up five regional offices as follows:—In London (2, Savoy Hill, W.C.2), to cover the areas of the London, Eastern, South Eastern and Southern Electricity Boards; in Manchester (36, St. Anne Street, 2) for the areas of the Merseyside and North Wales and North Western Boards; in Leeds (24, Aire Street, 1) for the areas of the Yorkshire and North Eastern Boards; in Birmingham (111, New Street, 2) for the areas of the Midlands and East Midlands Boards; and in Glasgow (29, St. Vincent Place, C.1) to cover the areas of the two Scottish Boards.

The new British Lighting Council plaque

Among the services which will be afforded by the Council is a lecture service which will be adapted to the needs of various classes of audience, e.g. medical officers of health, architects, industrialists, builders, chambers of commerce, women's organisations, and students and schoolchildren. The Council will also publish lighting information and data and make available photographs and lantern slides.

To indicate to the public where they can go for advice on lighting the Council has produced for the use of the organisations supporting it a 10in diameter plaque bearing the initials " B.L.C. " in the centre and the words " British Lighting Council " on its periphery. This is illustrated in the accompanying picture. Mr. D. Bellamy, O.B.E., is chairman of the Council and Mr. E. B. Sawyer, F.I.E.S., the secretary.

Harwell Reactor School

THE next standard course of the Harwell Reactor School in which places are available will commence on 1st September next and finish on 23rd December. The first six weeks of the course will be held jointly at Birmingham, Bradford and Salford Colleges of Advanced Technology, and the remaining part at the Harwell Reactor School commencing on 15th October. The fee for the course, which is open to British and overseas students, is £250. Selection of applicants will be made on 2nd June. Application forms and further details can be obtained from the Principal, Harwell Reactor School, A.E.R.E., Harwell, Berks.

VIEWS on the NEWS

By REFLECTOR

REFERENCE is made by the *Evening Standard* to a medical bulletin issued by the Ministry of Health in which the prevention of scalding accidents is dealt with. Good natural and artificial lighting of the kitchen is advocated and other safeguards are suggested. One of them I do not like; it is that "the cooker and sink should be joined so that kettles and saucepans do not have to be carried across the room." Such an arrangement may be in order where the cooker is a gas one, but I consider that to place an electric cooker near a sink would introduce much more serious risks than scalding.

* * *

The Midlands Electricity Board has been getting more kicks than the halfpence which it has been overcharging some of its consumers. But the Northern Area Gas Board has done better than this and has secured Parliamentary attention by sending one of its consumers a bill for £999,999 19s 11d when actually he had used no gas during the period concerned. The explanation given by Sir Ian Horobin (Parliamentary Secretary, Ministry of Power) was that

> "in order to get the advantages of mechanisation without spending money on a more elaborate machine, the machine which the Board used, under certain specific circumstances, did produce these freak results. The accounts were therefore given two separate manual checks, to take out these bills. By an extraordinary coincidence, in this one case both checks had failed. One-and-a-half million bills had been issued, and this was the first mistake."

* * *

Behind a paragraph in a report of the Ross and Cromarty Works Committee lies a strange story, which is related in *The Bulletin and Scots Pictorial*. The item in question referred to an estimate of £100 for the rewiring of the art block of Dingwall Academy. This work became necessary, *The Bulletin* says, because a sixpenny piece fell on to the element of an electric fire, with the following result:—

> "The electrical wiring was damaged; radiators, gas pipes, and water mains were electrified; a booster pump in the boiler house burst; and a pupil received a very slight electric shock."

It would have been better if this sixpence had gone the way of the one in the Scotsman's lament and blown the fuse.

* * *

Public address systems and other modern developments have very adversely affected the occupation (or calling) of town crier. These officials are, however, retained in a number of towns, particularly New Romney (Kent). At a recent meeting of the Town Council an extension of the town crier's duties was suggested—the crying of warnings of impending power cuts. A councillor said that if the town crier let people know in advance they could get their cooking done earlier. That suggested that power cuts were always premeditated whereas the Mayor (as reported by the *Folkestone Herald*) pointed out that "on the last occasion there was definitely a burning out or melting down; it was not a cut." Another member thought that swans had been the cause of most trouble. But, of course, swan songs would come too late to be a warning.

* * *

Knowing my liking for odd echoes from the past, Mr. Alec F. Plummer, of Luton, has sent me the following account of an alarming incident from the *Metal Bulletin* of 13th August, 1881:—

> "In one corner of Messrs. Weed, Parsons & Co.'s printing establishment stands the machine that furnishes the electric light for an adjacent store, the power coming from the engine of Weed, Parsons & Co. One feature of the machine is the armature—a wheel containing coils of insulated wire through which the electricity flows in powerful currents when the apparatus is in operation. This armature revolves with terrific velocity, and constitutes a powerful magnet. One day a young man came in and ground a pair of large scissors on an emery wheel near the generator. Turning to go out past the machine, he carried the scissors carelessly in his hand, when they were immediately drawn into the armature, and were soon revolving with it at a frightful speed. The young man got out of the way as quickly as possible, and was unhurt. For a few minutes the machine presented a very startling spectacle. The whirling scissors, twisted and broken, but still adhering to the revolving armature, began to cut the wires, and thus broke the electric current, which escaped in streams from the fractured ends of the wires, and in a moment or two that portion of the room was literally filled to the ceiling with whirling lightning. No one dared to approach for some little time, but the belt was finally thrown off, and the dangerous show was at an end."

* * *

Last week I mentioned the abortive attempt, fifty years ago, to institute a peat-fired power station in Ireland. Ten years earlier, a Shannon hydro-electric scheme was being considered although not until 1929 was the present Shannon scheme actually put into service. The *Electrical Review* of 15th April, 1898, said:—

> "A specially convened meeting of the Limerick Fishery Conservators was held on 7th inst. to hear a deputation from the Shannon Electric Power Syndicate with reference to the pending scheme for utilising the River Shannon in the production of electricity. Lord Lurgan, Colonel Sir Gerald Dease, Mr. H. J. Fuller, engineer, and other directors, attended to explain modifications of the original scheme. That scheme proposed the impounding of Lough Allen, and the conversion of the lake into a storage reservoir, the waters to be utilised on the gravitation principle. In reply to questions, Mr. Fuller said the horse-power to be used all the year round at the works at Castle Connell would be 5,000, the *maximum* being 10,000."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

In our last issue we reported the appointments of **Mr. H. A. P. Caddell,** M.A., M.I.E.E., as manager of the

Mr. H. A. P. Caddell

Mr. C. C. Pimble

South Staffordshire and North Worcestershire Sub-Area of the Midlands Electricity Board, in succession to Mr. T. G. Keeler, M.I.E.E., who is retiring at the end of May, and **Mr. C. C. Pimble,** M.I.E.E., M.I.Mech.E., engineer of the North Staffordshire Sub-Area, who will succeed Mr. Caddell as manager of that Sub-Area. We now reproduce their portraits.

Sir John Woods, G.C.B., M.V.O., a director of the English Electric Co., Ltd., has, owing to pressure of other work, resigned as chairman of the Board of Trade's Advisory Committee on the Revolving Fund for Industry. Sir John has been chairman since the Committee was appointed in July, 1953. The President has appointed **Col. E. R. Mayer,** T.D., D.L., managing director of Metlex Industries, Ltd., to succeed him.

The following appointments are announced by Creed & Co., Ltd.:—

Mr. S. E. Kirk has relinquished his position as general works manager and is appointed manufacturing adviser to the managing director. **Mr. C. H. Gladwell** is appointed general works manager, **Mr. K. J. Amos** becomes commercial manager, **Mr. F. S. Reade** is appointed sales manager (systems), **Mr. A. A. A. Grieve** is appointed sales manager (telegraph), and **Mr. J. D. Barker** assumes the title of publicity manager.

At the annual general meeting of Ericsson Telephones, Ltd., on 28th March, **Mr. F. Limb,** C.G.I.A., M.I.Prod.E., and **Mr. J. H. Mitchell,** B.Sc., Ph.D., F.Inst.P., M.I.E.E., were appointed to the board of directors.

Mr. Limb, who is appointed works director, commenced his career with the General Post Office in 1913. He joined Ericssons in 1925 as chief circuit engineer when the company entered the field of automatic telephones. During the war he turned his activities to the production side and in 1944 he was appointed production manager. He became assistant factory manager in 1949, joint factory manager in 1955 and factory manager in 1957.

Dr. Mitchell, who is appointed director of research, was educated at Crewkerne Grammar School and Bristol University where he gained first-class honours in physics, a first-class diploma in education and a Ph.D. degree. He worked for three years in the research laboratories of the British Thomson-Houston Co., Ltd., and then joined the Air Ministry where he pioneered in the development of radar, v.h.f. communication equipment and radio aids to navigation. He joined Ericssons in 1947 as controller of research. Dr. Mitchell was chairman of the Midland Centre of the Institution of Electrical Engineers three years ago and has served on the Council of the Institution. He is a founder of a

Mr. F. Limb

Dr. J. H. Mitchell

London City Livery Company and is on its Court of Assistants.

The retirement of **Mr. T. Kirkham** from the board for reasons of health was also announced at the meeting. Mr. Kirkham joined Ericssons as managing director in 1931 from which position he retired in 1945.

Mr. J. J. Gracie, C.B.E., a director of the General Electric Co., Ltd., and general manager of the Witton Engineering Works, who is at present visiting Australia, was recently entertained to luncheon at the St. James Hotel, Sydney, by members of the New South Wales Branch of the G.E.C. Overseas Club. Mr. Gracie said that everywhere he had gone in Australia he had been deeply impressed with the spirit of expansion and development.

Mr. E. J. Robertson, B.Sc.Tech., A.M.I.E.E., M.E.I.C., M.Amer.I.E.E., P.Eng., the author of the article on "Canadian Standards" (page 677), graduated in electrical engineering at Manchester University. He served a college apprenticeship with the Metropolitan-Vickers Electrical Co., Ltd., and then worked for the same company on power station layouts. In 1934 he joined the Traction Department of the English Electric Co., Ltd., and twelve months later was transferred to the company's London office. Early in the war he became an assistant mechanical and electrical engineer with the Air Ministry Works Directorate and supervised installation and maintenance work at R.A.F. fighter stations, including the radar stations in South-East England.

Mr. E. J. Robertson

In 1941 Mr. Robertson was appointed assistant electrical engineer to the Manchester Corporation Transport Department, and in 1945 was promoted to chief electrical engineer. He took up a position in the Electrical Department of the Toronto Transit Commission in 1949, assisting with the design of various electrical services for the Toronto Subway. Three years later he transferred to Bepco Canada, Ltd., to act in a technical liaison

Left to right: Mr. T. E. Morgan (chairman and managing director, British General Electric Co. (Pty.), Ltd.), Mr. J. J. Gracie (director and general works manager, Witton, G.E.C.), Mr. C. Drabble (director and chief engineer, B.G.E.C.), and Mr. A. P. Curtis (director and sales manager B.G.E.C.)

capacity on the subway cars which were to be manufactured in England by the Gloucester Railway Carriage Co., and on completion of this project he was transferred to Bepco's head office in Montreal. For the past two years Mr. Robertson has been with the Canadian Civil Service Commission, Department of Transport, Air Services Branch, and is now district electrical engineer at Montreal Airport.

Mr. P. Sellars has joined the board of Southern Instruments, Ltd., as vice-chairman. Mr. Sellars will be responsible for the overall co-ordination of the expanding activities of the company. A new laboratory wing is in course of erection which will increase the total existing floor space to about 70,000 sq ft.

Mr. R. K. Saunders has been appointed export sales manager of Ferranti, Ltd., and **Mr. J. C. Heywood** has been appointed instrument sales manager.

The Mansfield and North Nottinghamshire District of the East Midlands Electricity Board has now become the Mansfield and North Nottinghamshire Sub-Area and the former Worksop District has been reconstituted as a double headed District within the new Sub-Area. **Mr. A. Latham,** the present manager of the Mansfield and North Nottinghamshire District, has been appointed manager of the new Sub-

Mr. A. Latham

Mr. A. Elder

Area. **Mr. A. Elder,** at present group engineer (Derbyshire and Nottinghamshire) has been appointed regional engineer on the chief engineer's staff at Mapperley Hall.

Mr. W. P. Scott, manager of the Condensing Department of Worthington-Simpson, Ltd., has retired after holding this position for 22 years. The Condensing Department will now be administered from Newark by **Mr. T. Trowsdale,** condensing sales manager, and **Mr. T. Bennett,** condensing contracts manager, and all inquiries relating to condensing plant and associated equipment should, in future, be addressed to Newark.

Mr. G. S. Andrews, chief buyer of Ransomes, Sims & Jefferies, Ltd., retired on 31st March after fifty-five years' service with the company, and Mr. H. H. Dawson (works director) has presented him with a cheque on behalf of the directors and his colleagues. Mr. Andrews is being succeeded by **Mr. P. Dorling,** formerly of B. Elliott & Co., Ltd., Willesden.

At the recent annual dinner-dance of the North Midland Centre of the Institution of Electrical Engineers held at the Cairn Hydro Hotel, Harrogate. Mr. J. D. Nicholson (chief engineer, Y.E.B.) and Mrs. Nicholson being received by Mr. A. J. Coveney (Centre chairman) and Mrs. Coveney. Mr. W. K. Fleming (immediate past-chairman) and Mrs. Fleming

Mr. A. Porter, M.Sc., Ph.D. (Munich), A.M.I.E.E., who has been Professor of Light Electrical Engineering at the Imperial College of Science and Technology, London University, since 1955, has been appointed Dean of the College of Engineering in Saskatchewan University, Saskatoon. He takes up his new duties in October next.

The Minister of Power has appointed **Councillor J. Hobbs,** F.C.I.S., of Market Harborough, to be deputy chairman of the East Midlands Electricity Consultative Council with effect from 1st April, in succession to **Alderman J. W. Rayment,** J.P., of Lincoln, who has retired on completion of his term of office.

Philips Electrical, Ltd., announces the following appointments:—**Mr. J. D. Callaway** as manager of the Cardiff branch, **Mr. D. H. Clark** as television and radio manager, South-West Region, Bristol, and **Mr. A. D. Shillabeer** as electrical appliances manager, South-West Region, Bristol (effective from 1st May).

Mr. Callaway joined Philips as a lighting engineer with the Cardiff branch in 1951 after service with a London firm of consulting engineers and, earlier, with the Metropolitan-Vickers Electrical Co., Ltd. He is a member of the Illuminating Engineering Society and was chairman of the I.E.S. Swansea Group in 1950 and of the Cardiff Centre in 1956.

Mr. Clark has represented Philips television and radio in the West of Scotland since 1951. He was formerly with a firm of engineers.

Mr. J. D. Callaway

Mr. D. H. Clark

Mr. A. D. Shillabeer

Mr. Shillabeer has been a salesman since the end of the war. He joined Philips in 1950 and has covered territories in the West and the Eastern Counties of England as a representative of the electrical appliances division.

Mr. F. Faux, A.M.I.E.E., chief assistant engineer to the system planning engineer of the Central Electricity Generating Board, has been appointed station planning and development engineer of the Board.

Mr. F. Faux

Mr. Faux obtained his technical training at the Birmingham Central Technical College and was employed as a trainee with the Birmingham Corporation Electric Supply Department. He spent the next five years at the Hams Hall "A" power station, Birmingham. In 1933 he joined the Central Electricity Board, becoming assistant engineer in the Station Development Department at the headquarters of the Board in 1946 and, three years later, following the reorganisation of the electricity supply industry, senior assistant engineer in the Generation Design Branch, Chief Engineer's Department, British Electricity Authority, subsequently becoming specialist engineer and principal assistant engineer in the same branch.

He was appointed chief assistant engineer to the system operation engineer in 1954, and on the recent reorganisation continued as chief assistant engineer to the system planning engineer.

Mr. C. H. Flurscheim, B.A., M.I.E.E., Mem.A.I.E.E., chief electrical engineer of the Metropolitan-Vickers Electrical Co., Ltd., has been appointed a director of the company. Mr. Flurscheim was educated at Wellington College and Trinity College, Cambridge. He joined M-V as a college apprentice in 1927 and afterwards was on the staff of the Switchgear Engineering Department. During this time he spent a year with the General Electric (U.S.A.) as an I.G.E. fellowship student. In 1936 he took over the high-voltage division, switchgear engineering. During the war he was responsible for the development of a series of electrical components for aircraft, including electro-mechanical undercarriages, retraction units and miniature circuit-breakers. In 1945 he became assistant chief engineer, and in 1949 chief engineer, Switchgear Department. He was appointed assistant chief electrical engineer of the company in 1953 and became chief electrical engineer in February last year. Mr. Flurscheim has read many papers before technical institutions.

Mr. C. H. Flurscheim

The annual dinner-dance of the Midlands Branch of the **Electrical Trades' Commercial Travellers' Association** was held at the Pavilion Suite, the County Ground, Edgbaston, Birmingham, recently. Over 200 members and guests representing all sections of the electrical industry attended. The chairman, Mr. S. Le Marechal, proposed the toast to the guests and thanked Messrs. G. W. Arnold and J. T. Aitken for the pleasant way in which they had arranged the evening. The vice-chairman, Mr. T. C. Browne, proposed the toast to the ladies to which Mrs. Le Marechal responded.

The Branch snooker trophy final was held recently at the Grand Hotel, Birmingham. The winner was Mr. A. E. Bishop and the runner-up was the branch treasurer and charity steward, Mr. G. A. James. The presentations were made by Mr. Le Marechal.

At the annual dinner-dance of the E.T.C.T.A. Midlands Branch, showing the chairman, Mr. S. Le Marechal, with Mr. T. C. Browne, vice-chairman, Mrs. Le Marechal and Mrs. Browne

Mr. J. M. Hollander, B.Sc., M.I.E.E., has resigned his directorships in Electro-Mechanical Supplies, Ltd., Coventry, and Electro-Mechanical Supplies (Leicester), Ltd., and will now devote his whole time to the business of E.M.S. Electrical Products, Ltd., Kenilworth.

Mr. D. E. Anderson has been appointed assistant sales manager to George H. Scholes & Co., Ltd.

Mr. D. E. Anderson

Austin Crompton Parkinson Electric Vehicles, Ltd., has appointed **Mr. P. Rochs** as its public relations officer, operating from 95-99, Ladbroke Grove, London, W.11. It was in 1942 that Mr. Rochs, then in charge of the Lighting Engineering Department of Crompton Parkinson, Ltd., became sales manager of the newly formed Vehicle Division of that company. Upon the merger with the Austin Motor Co. and the formation of Austin Crompton Parkinson Electric Vehicles he became general sales manager. He has recently returned to business after a serious illness. The company has rearranged its area managers' territories with effect from 1st April.

Mr. D. D. Shears, hitherto deputy superintendent at Skelton Grange "A" power station, Yorkshire Division, C.E.G.B., has been appointed superintendent at that station. Mr. Shears entered the electricity supply industry in 1933, serving an apprenticeship with the Horsham U.D.C. From 1936 to 1940 he held positions at Hove, Newcastle-on-Tyne and Bradford. He served in the Royal Navy from 1940 to 1946, returning to Bradford on demobilisation. In 1951 he went to Skelton Grange and was mechanical maintenance engineer there until 1953, when he was appointed deputy superintendent at Wedgwood power station. Mr. Shears became deputy superintendent at Skelton Grange power station in 1955.

Mr. W. J. Weston, Associate I.E.E., M.Am.I.E.E., has been appointed Birmingham area manager of Lancashire Dynamo Group Sales, Ltd. Mr. Weston served an electrical apprenticeship with Baxter & Impey (Electrical Engineers), Ltd., Birmingham. He became assistant chief plant engineer of New Hudson & Girling, Ltd., Birmingham, in 1933 and chief plant engineer in 1938. Two years later he was appointed chief electrical engineer to Sir W. G. Armstrong Whitworth & Co., Ltd. Coventry. He joined Foster Transformers, Ltd. (a Lancashire Dynamo Group company) in 1949 and became senior branch engineer at the Birmingham area office of the Lancashire Dynamo Group in 1954.

Mr. W. J. Weston

Mr. P. J. L. Attwood, a director of Hoover, Ltd., and purchasing manager of the company, has completed 25 years' service and at an informal ceremony recently in the presence of fellow directors, Mr. S. Roberts, managing director, presented Mr. Attwood with a gold watch.

The South Western Electricity Board has appointed **Mr. E. M. Hughes,** M.B.E., its establishments officer, to be deputy secretary as from 1st April. Mr. Hughes joined the Board in 1948 as assistant secretary (establishments) and later was appointed establishments officer. Before going to Bristol Mr. Hughes was chief executive officer to the Ministry of Fuel and Power at Nottingham.

Mr. E. M. Hughes

The Council of the **Combustion Engineering Association** has appointed the following to hold office for the year 1958-59:—President, Mr. S. P. Chambers, C.B., C.I.E., B.Comm., M.Sc.(Econ.) (Imperial Chemical Industries, Ltd.). Vice-presidents, Sir John Charrington (Charrington, Gardner, Locket & Co., Ltd.), Mr. G. D. Elliott (John Thompson (Australia) Pty., Ltd.), Mr. H. C. Hawkins, M.Inst.F., A.M.I.Mech.E. (British Xylonite Co., Ltd.), Sir Percy Sanders, C.B.E., J.P., A.M.I.Mech.E. (Davey,

Paxman & Co., Ltd.), Mr. R. H. E. Thomas, O.B.E. (National Coal Board) and Sir Edward Thompson, J.P., M.A. (John Thompson, Ltd.). Chairman of the Council, Mr. L. N. Horne, F.Inst.F., M.Inst.T. (Charrington, Gardner, Locket & Co., Ltd.). Hon. treasurer, Mr. E. W. Barnes, M.Inst.F. (Riley (IC) Products, Ltd.).

Mr. J. W. Gibson, M.Eng., A.M.I.E.E., has joined the technical staff of Line Equipment, Ltd., at Bridgend, Glamorgan. After graduating at Liverpool University, Mr. Gibson joined the Metropolitan-Vickers Electrical Co., Ltd., initially as a college apprentice, and subsequently held appointments with the General Electric Co., Ltd., at Witton and with Electric Transmission, Ltd., Stoke-on-Trent. Mr. Gibson is well known for his work on fuses of various types and has taken an active part in national and international fuse standardisation work.

Mr. J. C. Silverthorne has been appointed area manager, East Midlands area, of Sangamo Weston, Ltd. He joined the Contracts Department in 1951 as assistant area manager, Merseyside and North Wales area. In his new appointment Mr. Silverthorne will operate from the area office of the company at 8, Thurland Street, Nottingham.

Mr. J. C. Silverthorne

We are asked to say that **Mrs. D. A. White,** who appeared in the photograph reproduced in our issue of 28th March (page 594), is the widow of the former chairman of Ashley Accessories, Ltd., Mr. E. T. White.

Mr. R. V. Banks has been appointed manager of the Maidstone branch of Siemens Edison Swan, Ltd. He was educated at Dean Close School, Cheltenham, and received his technical education at the City and Guilds (Engineering) College, South Kensington. He began his career with the Franco-British Electrical Co., Ltd., Hendon, and in January, 1926, joined the Edison Swan Electric Co., Ltd., at its Ponders End Works, eventually transferring to the Brighton office, later moving to Kent.

Mr. R. V. Banks

Mr. Banks has been Kent branch secretary of the Association of Supervising Electrical Engineers since 1949, and is a member of the National Executive Council. He is also a member of the Illuminating Engineering Society and of the Association of Mining Electrical and Mechanical Engineers.

Mr. H. H. Broughton, the author of the article on "Modern Electric Crane Control" which appears in this issue (page 681), has been actively interested in the standardisation of cranes since 1926, which work can be regarded as an essential part of materials handling, and it is in the latter branch of engineering that he has specialised as a consultant. He has contributed papers to engineering institutions at home and abroad; has served on numerous committees; and has written standard works on electric winders and electric cranes.

Mr. H. H. Broughton

Mr. A. Wynn has resigned as chairman and joint managing director of the Midland Electric Manufacturing Co., Ltd., and **Mr. W. J. Barber,** who was also joint managing director, has been appointed chairman and is now the sole managing director. **Mr. E. Withington,** who has been a member of the board for 23 years, has resigned the position of deputy chairman but has agreed to continue as a director. Mr. Wynn has been appointed deputy chairman in his place.

Mr. J. E. Walker, A.M.I.E.E., who writes in this issue on "Underground Cable Laying" (page 696), received his technical education at the Mechanics Institute, Stratford, Rutherford College, Newcastle, and the Northampton and Regent Street Polytechnics, London. He was an electrical apprentice with the L.N.E.R. and a special trainee with Crompton Parkinson, Ltd. He joined the Northmet Power Co. as assistant engineer in 1933 and became assistant superintendent of the Stevenage district. On nationalisation he was made district engineer at Stevenage, and in 1952 he was appointed to his present position of district engineer to the Great Yarmouth and Lowestoft District of the Eastern Electricity Board.

E.D.A. Annual Luncheon

Sir Christopher Hinton, chairman of the Central Electricity Generating Board, will be the principal guest and speaker at the annual luncheon of the British Electrical Development Association at the Connaught Rooms, London, W.C.2, on 13th May. Other speakers will be Sir Arthur fforde, chairman of the B.B.C., and Viscount Chandos.

The annual general meeting will be held after the luncheon.

OBITUARY

Mr. Percival Andre Lundberg, M.I.E.E., formerly managing director of A. P. Lundberg & Son, Ltd., died on 6th April, at St. Leonards-on-Sea, at the age of 89. The business of A. P. Lundberg was taken over by the Simplex Electric Co., Ltd., some years ago.

Mr. Frank C. Horsford, Associate I.E.E., who retired from the position of manager of the Birmingham branch of W. T. Henley's Telegraph Works Co., Ltd., in 1956 for health reasons, died on 31st March. Mr. Horsford joined Henley's in 1911, was appointed engineering sales representative for the London area in 1922, and engineering sales superintendent in 1942. He went to Birmingham as branch manager in 1947.

Mr. D. E. Whalley, A.M.I.E.E., who until his retirement in July last year, was assistant divisional engineer (electrical) in the Chief Engineer's Department of the London County Council, died in hospital on 25th March at the age of sixty-five. Mr. Whalley joined the L.C.C. in 1925 and for many years was in charge of the section responsible for electrical installations in the Council's schools.

Mr. A. R. Clague.—We regret that Mr. Arthur Ronald Clague, M.Eng., A.M.I.Mech.E., A.M.I.E.E., who was appointed controller of the South Western Division, Central Electricity Generating Board as recently as January, died on 6th April. Mr. Clague was born at Bidston, Cheshire, in 1906. After graduating from Liverpool University he served an apprenticeship with the Metropolitan-Vickers Electrical Co. and remained with that company until 1935 when he joined the Belfast Corporation Electricity Department as assistant technical engineer. He became assistant power station superintendent at Belfast but left in 1944 to take up the position of assistant generation engineer with the West Midlands Joint Electricity Authority and in 1947 he became generation engineer. Upon the nationalisation of the electricity supply industry in 1948 he was appointed generation engineer (operation) in the Midlands Division of the B.E.A. and five years later became chief generation engineer (operation).

The late Mr. A. R. Clague

Mr. W. T. Briggs.—The death occurred on 6th April, at the age of 81, of Mr. William Thomas Briggs, A.M.I.E.E., late of the Egyptian State Railways.

Mr. John Marriott Buer, of Torquay, who died on 26th March, had been an associate member of the I.E.E. since 1912.

TRENDS IN DOMESTIC CONSUMPTION

Final Results of Sample Survey

THE Electricity Council have now issued the completed results of the 1955 Sample Survey of Domestic Consumers carried out as part of their utilisation research programme (Report No. 7). Much of the infomation has already been given in three interim reports which were described in previous issues of the *Electrical Review* (4th May, 1956, 23rd August, 1957, and 8th November, 1957) and the present report consolidates these results in a convenient and well-presented form. The survey, said to be the largest systematic sample survey of domestic electricity consumers ever undertaken, was carried out in the first quarter of 1955 and covered one in every thousand of the 12 million domestic consumers connected at that time.

The results show that one in every four consumers used electric cooking, and one in every five electric water heating. (If "breakfast" and "baby" cookers are excluded the saturation figures for cooking and water heating are exactly the same, namely 21 per cent.) Although the consumptions attributable to these and other services were not obtainable directly from the results of the survey they were estimated approximately by means of a statistical analysis. It appears that the average yearly consumption of a full-size cooker is about 1,400 kWh, and that of an immersion heater slightly less (1,200 kWh). Grouping in the smaller cookers on the one side and the smaller sink-heaters and washboilers on the other the consumptions for cooking and water-heating are fairly nearly equal. Expressed as a proportion of total annual consumption, cooking accounts for just a quarter, water-heating and space-heating each slightly less than a quarter, and lighting, etc., slightly more.

Less important from the load-building point of view are the saturation figures for apparatus in the "luxury" class whose purchase price is high in relation to its energy consumption and for whose service electricity meets little competition. Saturations range from 35 per cent for television sets through 17½ per cent for washing machines and down to 8 per cent for refrigerators. Whilst the last two figures are not high they show a very large increase over those in the previous survey. In fact the number of consumers having electric washing machines has gone up nearly nine times, and those having refrigerators nearly four times, in the space of nine years.

Particular attention was paid to space-heating installations, and the results were analysed in respect of location. About 60 per cent of consumers possessed one or more electric space-heaters, representing an aggregate installed load of no less than 17,000 MW. More than half of this load was used for living-room heating and 38 per cent for bedrooms. The average heater capacity was in the range 1·3 to 1·5 kW for all types of room.

Referring to the seasonal variation of consumption, the survey figures are compared with the Area Board returns, and the smooth curve approximating the results appears to follow something like a sine wave. Whilst both lighting and space-heating tend to produce winter consumption peaks there are some minor contrary effects. Thus it is noted that over 40 per cent of the consumers with immersion heaters said they hardly used it at all in the winter.

A similar survey was carried out in 1946 under the auspices of the Electrical Research Association. Although in a number of minor points the two sets of results are not strictly comparable they are sufficiently similar to give a very useful picture of the trend of domestic electricity usage over the nine years. The table gives the 1955 results and the percentage by which they have risen above the 1946 figures.

Average Saturation Factors (S.F.)

	1955	Increase over 1946
Annual Consumption	1,540 kWh	28%
Electric Cooker (all types) S.F. ...	24·5%	48%
Electric Cooker (full size) S.F. ...	21·0%	—
Gas Cooker, S.F.	67·2%	−10%
Other Cookers, S.F.	21·3%	−13%
Immersion Heater, S.F.	16·4%	119%
Large Self-contained Water Heater, S.F.	1·6%	78%
Electric Space-Heating, S.F.	60·5%	−1%
Gas-Heating, S.F.	14·7%	25%
Washing Machine, S.F.	17·5%	775%
Refrigerator, S.F.	8·1%	268%

NEW BOOKS

Electricity in Building. By A. L. Osborne, F.R.I.B.A. Pp. 160; figs. B. T. Batsford, Ltd., 4, Fitzhardinge Street, Portman Square, London, W.1. Price 25s.

The technical knowledge in this book will be acquired by electrical engineers during their training and experience; and architects, except in the case of domestic premises, should not be encouraged to design installations. Nevertheless, the great merit of a book like this is that it gives the approach of both professions to the common task of completing a building, and is thus of value to each.

Mr. Osborne is an enthusiastic protagonist of electricity. An architect by training, he has absorbed his electrical knowledge through harsh necessity and a more than usual interest; and in this book he is aided by the British Electrical Development Association. The result is an excellent work, among the best of its kind, and one that can be recommended to all associated with building construction.

General principles, wiring systems and electrical space heating are well covered and the chapter on electrical water heating, with or without associated boilers, is admirable. The chapter on lighting covers rather too much ground in a short span.

Among flaws noted are the use of a small "m" in MW, a lack of precision in the section on domestic ring circuits, a statement that a lighting sub-circuit is limited to 1,000 W, and another that the permitted discharge lamp loading on a final sub-circuit is only half that for tungsten lamps, instead of 80 per cent for the sub-circuit and 50 per cent for an ordinary switch. No doubt these points will be corrected if the book reaches a deserved second edition.

—H.R.M.

Electrical Engineer's Reference Book. Edited by E. Molloy. Pp. 33-28; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 80s.

Electric Lifts. By R. S. Phillips. Pp. 411; figs. Sir Isaac Pitman & Sons, Ltd., Kingsway, W.C.2. Price 63s.

INDUSTRIAL NEWS

Economic Survey 1958

Despite its title the Government's *Economic Survey 1958* devotes only two of its sixty pages to the country's present position and to the problems of 1958; the rest is concerned with a historical review of the past year and in this the balance of payments problem figures largely. As the latest results show, there has been in recent months a marked restoration of confidence in sterling and this, coupled with the favourable balance of trade, has led to a healthy increase in the country's reserves. But as the *Economic Survey* points out, much of last year's prosperity was sustained by a relative fall in the price of imports rather than by our own efforts in production and exports. In fact the volume of exports last year expanded by only 2 per cent, which was a smaller increase than in any year since 1953. The expansion was also confined to the first nine months, and in the last quarter exports were 2 per cent lower than in the previous year, although engineering exports suffered less than most. The engineering industries were also mainly responsible for the increase in total output during the year, and in general steel was no longer a limiting factor.

Costs and prices, the *Survey* states, are the first problem confronting the economy of the United Kingdom in 1958. Since most of the fall of 8 per cent in import prices took place in the second half of last year, it should be reflected to some extent in the final prices of British manufactures in 1958 provided it is not offset by increases in labour costs. In addition the wholesale prices of manufactures were stable in the fourth quarter of last year and the long upward trend of British export prices was checked. Consequently the *Survey* considers that 1958 offers a good opportunity to "stop the rise in prices that has troubled the country for twenty years." This, it says, is desirable for economic and social reasons at home and in the interests of Britain's overseas trade. Conditions in overseas markets are likely to be "difficult and British manufacturers will be able to succeed only if they can keep prices down."

The country's ability, the *Survey* concludes, to exert its influence on world economic affairs in a positive direction depends upon its "own economic strength; upon its ability to deal effectively with its own economic problems; and, in particular, upon the maintenance of the internal and external value of the currency."

Edmundsons' Acquisition

Edmundsons Electric Co., Ltd., has acquired the share capital of Electro-Mechanical Supplies, Ltd., Coventry, and Electro-Mechanical Supplies (Leicester), Ltd. The directors of Electro-Mechanical Supplies, Ltd., are: Messrs. G. Lockwood (general manager), E. H. Maltby, Noel G. Smith and A. H. Young. The directors of Electro-Mechanical Supplies (Leicester), Ltd., are: Messrs. G. Lockwood (general manager), H. S. Kirk, E. H. Maltby, Noel G. Smith and A. H. Young.

Electricians' Wage Claim

It was reported last week that in response to a claim for higher wages from employees in the electrical contracting industry the National Federated Electrical Association had offered an extra 1d an hour—3s 8d a week. Apparently the offer was related to a cost-of-living increase given to building trade workers who, incidentally, are pursuing a further claim. The Electrical Trades Union, while expressing dissatisfaction with the offer, agreed to consider it.

Welding School Prospectus

The Institute of Welding, 54, Princes Gate, Exhibition Road, London, S.W.7, has issued a prospectus giving details of the courses which are being offered by the School of Welding Technology between April and September.

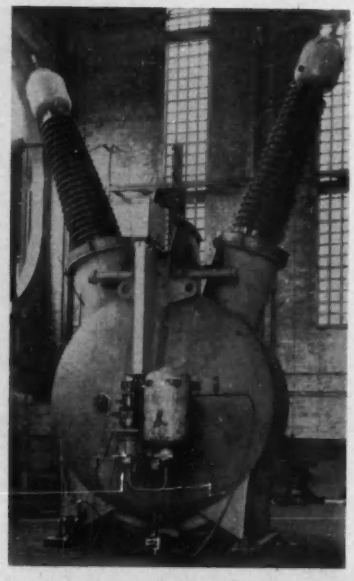
Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £175 10s 0d
Fire Refined 99·70%	ton £174 0s 0d
Fire Refined 99·50%	ton £173 0s 0d
COPPER Tubes ..	lb 1s 9d
Sheet	ton £205 5s 0d
H.C. wire and strip ..	ton £226 5s 0d
LEAD, English ..	ton £72 10s 0d
Foreign	ton £71 0s 0d
MERCURY	flask £77 0s 0d
TIN, block (English) ..	ton £731 0s 0d
ZINC, G.O.B. Foreign	ton £62 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 5½d
Sheet	ton —
Wire	lb 2s 3½d
PHOSPHOR BRONZE Wire	lb 3s 6½d
PLATINUM	oz £26 15s 0d
RUBBER, No. 1 R.S.S. spot	lb 23d—23½d

330 kV Lenticular Circuit-Breakers

The accompanying picture shows a prototype 330 kV lenticular tank oil circuit-breaker manufactured by the British Thomson-Houston Co., Ltd., at Willesden, which has been erected for short-circuit tests at the Switchgear Testing Co.'s works at Manchester. The B.T.H. Co. is supplying twenty-three such circuit-breakers for the Kariba hydro-electric scheme.



B.T.H. prototype 330 kV lenticular tank oil circuit-breaker erected for short-circuit tests at the Switchgear Testing Co.'s Manchester works

Training in the Steel Industry

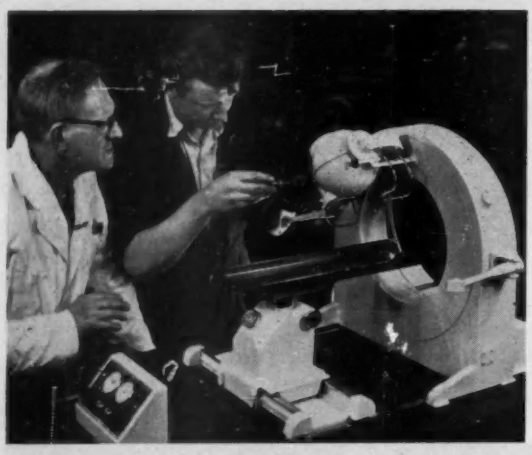
The United Steel Companies, Ltd., 17, Westbourne Road, Sheffield, 10, has issued two booklets, "Careers for Graduates" and "Training for Student Apprentices," describing the facilities and careers available in the company.

E.D.A. Public Speaking Competition

The final stages of the Yorkshire Area Competition were held at the offices of the Central Electricity Generating Board, Leeds, on 18th and 19th March. Mr. A. Haselhurst, chief commercial officer of the Yorkshire Electricity Board, opened the proceedings on the first day and Mr. D. Bellamy, chairman of the Board, on the second day.

The first day was devoted to the men's section, the judges being Mrs. C. Renton-Taylor, member of the Board, Mr. P. Santangelo, general administrator of the New Theatre, Hull, Mr. K. H. Potts, chief prosecuting solicitor, Leeds Corporation, and Mr. J. A. Stedman, education officer, E.D.A. The winner was Mr. P. G. Cope, second assistant engineer, No. 5 (Wakefield) Sub-Area, whose talk was entitled "How Advertising Helps the Consumer." The second prize was awarded to Mr. J. S. Senior, sales representative, Keighley District, No. 1 (Bradford) Sub-Area, who spoke on "Food Hygiene."

In the women's section, on the second day, the judges were Alderman Mrs. K. Chambers, Mr. Santangelo,



Putting the finishing touches to the Newton Victor "Orbitron" model at the M-V Apprentice Training School

Mr. W. W. Martin, deputy city treasurer, Leeds, and Mr. Stedman. The winner was Miss Valerie M. Hill, demonstrator, Rotherham District, No. 3 (Sheffield) Sub-Area, who spoke on "How Advertising Helps the Consumer." The second prize was won by Miss Mary N. Townsend, trainee demonstrator, No. 4 (Leeds) Sub-Area, whose subject was "Electricity and Leisure." The men's prizes were presented by Mrs. Renton-Taylor and the women's prizes by Mr. Bellamy.

C.E.G.B. Transformer Contract

The Willesden Transformer Co., Ltd., has been awarded a contract for 50 kVA transformers by the Central Electricity Generating Board for the Rheidol power station and the Ffestiniog pumped storage scheme.

Model Radiotherapy Unit for Vancouver Fair

A quarter scale model of the Newton Victor "Orbitron" radiotherapy unit recently left by air for the stand of the Metropolitan-Vickers Electrical Co., Ltd., at the British Columbia International Trade Fair, Vancouver. The model has been built entirely by apprentices and their instructors at the M-V Apprentice Training School. The "Orbitron" employs radioactive cobalt 60 as a source of radiation and this nuclear-reactor - produced isotope emits radiation similar to radium or to an X-ray tube working at three million volts. The source, measuring 2 cm diameter by 3 cm long and housed in a spherical protective container, is sufficient to treat thousands of patients in hospital before it has to be replaced after about five years.

Henley-T.I. South African Agreement

W. T. Henley's Telegraph Works Co., Ltd., and Tube Investments, Ltd., announce that an agreement has been reached for the merging under the name of Henley-Simplex Africa (Pty.), Ltd., of their businesses in South Africa previously carried on by Henley's (South Africa) Telegraph Works Co., Ltd., and Simplex Electric Co. (South Africa) (Pty.), Ltd.

Substation Plant for Argentina

The Metropolitan-Vickers Electrical Co., Ltd., has received an order valued at approximately £5 million from Agua y Energia (the Argentine Power and Water Board), for the supply and construction of seven 132 kV substations to be installed in the Buenos Aires city area. The order is the largest for this type of equipment ever placed with the company. In addition to supplying the complete electrical equipment Metropolitan-Vickers will act as main contractors for the civil work which will be carried out by local contractors. The contract value includes about £1 million for the civil work.

Atomic Agreement with Italy

A draft decree to bring into full and immediate effect the bilateral agreement with Britain for co-operation in the peaceful uses of atomic energy was signed last week by President Gronchi. Reporting this, the Rome correspondent of *The Times* added that by his action the President has removed what would have been a serious obstacle to British firms which intend to compete in April for the S.E.N.N. company's contract for the next projected nuclear power station in Italy. The difficulty arose when the Italian Parliament was dissolved before it had time to approve the agreement, under which the A.E.A. undertakes to make fuel available to Italy for research and operating reactors.

Price Reductions

Reductions of up to 20 per cent in the list prices of its most popular sizes and types of wiring cables are announced by Mersey Cable Works, Ltd. The new prices are given in price list No. 52.

Mullard, Ltd., announces reductions in the prices of certain types of television tubes.

"Deltic" Locomotives for British Railways

A fleet of twenty-two locomotives of the "Deltic" type designed and built by the English Electric Co., Ltd., is being ordered by the British Transport Commission. The locomotives, which will go into service between London, Newcastle, Edinburgh and Leeds, will be built at the Vulcan Foundry, Ltd., Newton-le-Willows.

The order follows the use of the company's existing "Deltic" locomotive, the most powerful yet built in Britain, on trials in regular service on British Railways since November, 1955. Deliveries will begin in 1960,

Express train hauled by an English Electric 3,300 h.p. diesel-electric "Deltic" locomotive leaving Lime Street Station, Liverpool, for London

and it is expected that by mid-1961 all the locomotives now ordered—in replacement of fifty-five main-line steam locomotives—will be in use on such trains as the "Flying Scotsman," the "Elizabethan," the "Talisman," the "Yorkshire Pullman" and the "Tees-Tyne Pullman." Eight will be allocated to King's Cross (Eastern Region), six to Newcastle (North Eastern Region) and eight to Edinburgh (Scottish Region).

The locomotives will each be powered by two 1,650 h.p. Napier "Deltic" engines, each driving a 1,100 kW main generator and a 45 kW auxiliary generator. They will have a CC wheel arrangement (two six-wheeled bogies); will be numbered D1000-D1021; and will be classified as Type 5 in the British Railways classification of main-line diesel locomotives.

Square D Exhibitions

A series of exhibitions displaying the products of Square D, Ltd., as shown at the Electrical Engineers' Exhibition at Earls Court, is to be held in eleven cities throughout Northern England and Scotland from 18th April to 21st May. The display stands and product panels shown at Earls Court were built for easy dismantling and reconstruction for exhibition in hotels.

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 21st March is deemed to be 186s 6d.

The "costs of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 21st March is 177·0 (1949=100) and 114·0 (1954=100); both figures are provisional. For turbo-generating and allied plant: Materials used in mechanical engineering industries 185·6 (1949=100) and 123·2 (1954=100), blast furnaces and iron and steel melting and rolling (40 and 41) 192·0 (1949=100) and 130·8 (1954=100); both figures are provisional. The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 28th March) is 41¼d per lb.

Metal Industry Handbook

The 1958 edition of the "Metal Industry Handbook and Directory" is now available from Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, price 15s (postage 1s 6d). It is a standard work of reference offering a comprehensive source of information to all those engaged in, or connected with, the non-ferrous metal industries, and information on the properties of the newer as well as the more familiar metals has been brought up to date.

A section devoted to summaries of British Standard aircraft material, D.T.D., and Admiralty specifications has again been included. There is also a section on the chief metal finishing processes and data regarding all the common rod, bar, sheet and strip products and, for buyers, a wide range of producers, stockists and factors of all basic metal products, metal working machinery and tools, and metal finishing equipment is listed.

The handbook, which is now in its 47th year of publication, is issued free to subscribers of *Metal Industry*.

Middle East Industrial Projects Corporation

The Federation of British Industries announces the formation of an international organisation called MIDEC S.A. "to further the development of industrial projects in the Middle East in conjunction with Arab and other local interests." Its registered office is in Luxembourg (Rue Aldringer No. 14) and it has branches in The Hague and Beirut. The present participating countries are Belgium, Canada, Denmark, France, Western Germany, Holland, Italy, Norway, the United Kingdom, Sweden, Switzerland and the United States. The total initial share capital of MIDEC S.A. is 1 million Swiss francs.

The shares in MIDEC allotted to the United Kingdom have been taken up by a banking group; by a contracting group consisting of Balfour, Beatty & Co., Ltd., and Taylor Woodrow (Overseas), Ltd.; and a manufacturing group which includes Associated Electrical Industries, Ltd., the British-American Tobacco Co., Ltd., the Dunlop Rubber Co., Ltd., the Guest Keen Iron & Steel Co., Ltd., Imperial Chemical Industries, Ltd., Platt Bros. & Co. (Holdings), Ltd., the Power-Gas Corporation, Ltd., Schweppes, Ltd., and Standard Telephones & Cables, Ltd.

Plastics in Lighting

An exhibition of the uses that are made of I.C.I. plastics in modern lighting fittings was held last week at the Mayfaria, 32, Bryanston Street, London, W.1. The 170 fittings and many photographs on show covered almost all aspects of industrial, commercial, street, transport and domestic lighting and ranged from a lighthouse beacon to a dental inspection lamp. There were also several prototype and experimental fittings.

The applications of "Perspex" occupied the major part of the exhibition. It was pointed out that this material is now available in a number of grades, each one possessing special optical characteristics. Attention was drawn to the many fittings that have been developed with "Perspex" that would not have been possible with glass because of the risk of breakage. Other fittings illustrated the durability, optical efficiency and resistance to corrosion of this material. In the domestic section there were some interesting examples of contemporary designs from the Continent.

The other two materials covered by the exhibition were "Diakon" acrylic moulding powder, which is used to produce injection moulded and extruded components with the same characteristics as "Perspex"; and "Darvic" p.v.c. sheet and foil, which is notable for its high impact strength, rigidity in thin sheets and resistance to a wide range of chemicals. It can be bent without heat by conventional metal-pressing techniques.

Part of the I.C.I. "Plastics in Lighting" Exhibition

Trade Announcements

The Bury St. Edmunds branch of **Cryselco, Ltd.,** has moved to Well Street Corner, Bury St. Edmunds (telephone: Bury St. Edmunds 1221).

British Resin Products, Ltd., announces that the high density polyethylene which it is marketing on behalf of British Hydrocarbon Chemicals, Ltd., will in future be sold under the trade mark "Rigidex." The following appointments have been made:—Sales manager, Mr. J. D. Winston; assistant sales manager, Mr. G. E. H. Smock; development manager, Mr. D. N. Davies; and service manager, Mr. P. Brown.

English Clock Systems and **Smiths Industrial Instrument Division** (both members of the Smiths group of companies) have opened a combined showroom and offices at 184, Corporation Street, Birmingham, 4 (telephone: Central 8737). The Service Department of English Clock Systems will operate from the new address.

Short & Mason, Ltd., 280, Wood Street, Walthamstow, London, E.17, have signed an agreement with Akt.-Ges. Chemisches Institut Dr. A. G. Epprecht, Zurich, whereby they will act as sole agents in Great Britain for the range of Drage instruments.

The Midlands office of **Barlow-Whitney, Ltd.,** is now at 44, Queen's College Chambers, Paradise Street, Birmingham, 1 (telephone: Midlands 6897), which is now the headquarters of the Midland area manager, Mr. H. Melrose.

Underground Cable Laying

Review of Modern Techniques

By J. E. WALKER, A.M.I.E.E.*

TECHNIQUES of cable laying have been very considerably influenced by the development of the power cable. Towards the end of the last century the development of the incandescent lamp did more than anything to hasten the need for means of distributing power. In the years between 1885 and 1890 there was great controversy over the merits of low-voltage d.c. and the more recent innovation of high-voltage a.c.; the unit range of the former restricted the distribution from one generating station to about a quarter-of-a-mile, but with the latter, as Ferranti clearly saw, with the application of high voltages it would be possible to transmit much greater distances thus keeping the generating stations on the fringe of the urban areas. Through his wise counsel as chief engineer this was carried out by the London Electricity Supply Corporation when they sited their power stations at Deptford. Ferranti thus designed his tubular main to run at 10 kV, which by virtue of the rigidity of the materials used was made in 20ft lengths. Altogether 27 miles of this main were laid involving some 7,000 straight joints. It will clearly be appreciated that the cable laying techniques of those days were vastly different from present-day practice, where lengths of relatively flexible cable can be made to nearly any requirement and indeed lengths of up to 2,000 yd have been installed in this country, submarine cable excluded.

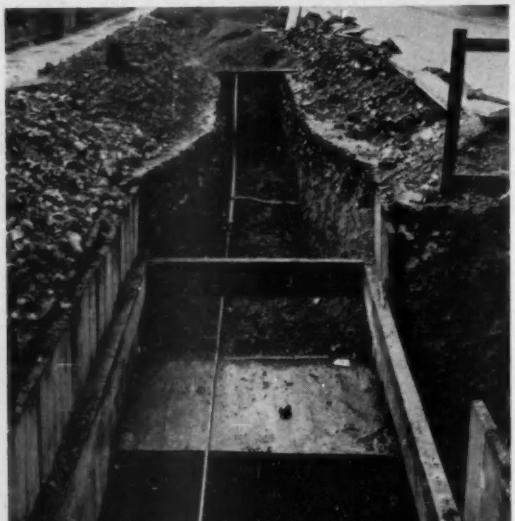
There was to begin with general reluctance to adopt underground power transmission because of the danger of ingress of water. Some people favoured the practice of running the cable in pipes, while others were in favour of rendering the cable waterproof and laying it direct in the ground. In Britain the tendency was to the direct method, but in the United States ducts were favoured. In the urban parts of this country ducts have definite advantages, particularly where the pavement is congested with various services which of necessity are placed one above the other, not to mention the growth of load and relative ease of changing the cable.

I think it would be true to say that since the initial techniques of cable manufacture were established there has been very little advance in the techniques of laying cable in urban areas where other services restrict the use of mechanical excavators. Far too often has the indiscriminate use of these machines been the cause of damage to other services, electricity not being the least of those where the damage may not give trouble until some time has elapsed. When we leave the urban areas then overhead construction is very much cheaper and, to enable the authorities to carry out as much development as possible with the money available, must be used wherever possible.

During the last war when the labour resources were inadequate, the then Northmet Power Company used a special type of plough to lay 4½ miles of 0·1 sq in three-core 11 kV unarmoured cable over a cross-country route. The work was undertaken by Clough Smith & Co., who later developed machines for laying 33 kV cable, at the same time surrounding it with a concrete grout for protection. The whole of the 4½ miles of cable, including hand excavation at road crossings, ditches, etc., was completed by 20 men in three weeks, an average of 500 yd per working day. The rate of ploughing was 15 yd per minute and under favourable conditions 1,000 yd of cable was installed in one day. Had it not been for mechanical trenchers and the use of calfdozers for filling in, the development of the new towns, which were such a drain on local labour, would have seriously embarrassed the supply companies.

The author was for some time associated with the

* Eastern Electricity Board.



This "American head" allows a direct pull on the cable cores as well as the sheath

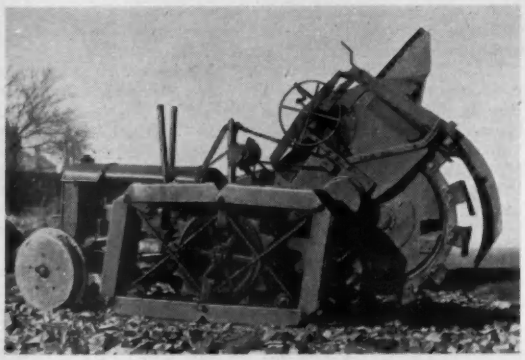
The calfdozer is a useful machine for backfilling

development of one of the new towns north of London where a small mechanical trencher of the winch type, capable of being loaded on to a trailer, was used with a gang of five men. The backfilling was by calfdozer and mechanical punners. The Development Corporation of this particular town was very helpful in organising the laying of various services; each was given a definite strip and it was possible to lay the mains before any of the other services were installed. Extra men were drafted to site for pulling in the cable.

The cable plough method of laying is mainly suitable for a route of some length across open country with no obstacles. Mechanical trenchers of the type shown in the accompanying photographs were much more useful along the verge, although a fair proportion of the work must sometimes be hand excavated.

Where the trench is mechanically excavated it follows that there is lack of labour for pulling the cable off the drum into the trench, particularly where the larger cross-sections of cable are used. A mechanical winch is mainly used, together with cable rollers, but care must be exercised in applying the pulling tension to the cable. It is customary to pull in by applying the pulling tension to the armoured wires, thus for extra tension the conductors and armouring are bonded together in a common pulling eye or shackle. As a guide, it is considered that for armoured cables the safe maximum figure would be of the order of one-sixth of the maximum breaking load of the armoured wires. To arrive at the latter, see Spec. C2 (1955) which gives for all standard cables the approximate number and diameter of the armoured wires which enables other approximate orders to be determined very readily in any specific case. The normal tensile stress for galvanised steel wire is 25 tons/sq in and from these data it is possible to determine approximately the maximum permissible pull.

In the case of lead-covered cables in which the conductors themselves would be used, we should allow the same factor of safety but, bearing in mind that the tensile strength of the copper is of the order of 16 tons, for



Typical mechanical trencher

0·1 sq in three-core cable the maximum pulling tension should not exceed one ton. Arrangements can be made with the manufacturers for the leading end of the drum lengths to be provided with surplus lengths of armour wire so that this can be finally made off to the swivel shackle of the winch rope.

If the cable is not wire armoured it is often necessary to make-off the pulling eye direct to the conductors which are brought out through the plumbed end of the cable. It is a safe precaution to use a dynamometer to ensure that

Pirelli 33 kV oil-filled cable being laid in Norwich

the maximum tension does not exceed the figure recommended for that particular cable.

When Pirelli-General Cable Works, Ltd., laid the 33 kV oil-filled cable in the Norwich District of the Eastern Electricity Board, the use of "walkie talkies" made it possible to co-ordinate man-power along the route of the trench and the winch since in this case there was a bend in the length of trench opened.

The installation of oil-filled cable makes the contours of the cable route important for fixing the position of header tanks to maintain the oil in the cable. The installation of such a cable has been carried out recently where the cable was in the highway for most of the way. It was found that by breaking the top layer of tarmac with pneumatic drills along the line of the trench and removing the lumps for later temporary reinstatement, it was possible to follow up with a trencher down to the depth of the shallowest service crossing the route. The final stage was carried out by hand digging in relatively sandy soil. Each 500 yd length of cable was hauled by manual labour only into the trench. The manual force on the job was augmented by the introduction of labour from some distance away for this particular operation, so that in this instance both mechanical aids and manual labour worked in harmony to the greatest effect.

Thrust boring serves a very useful purpose where the cable is to be laid after the roads are constructed and there are several machines on the market. The Postmaster General's Department in the Commonwealth of Australia has been operating a new horizontal earth auger with some success. It is claimed that it is able to bore under the road without disturbing the surface which in some types of soil can be one disadvantage of ordinary thrust boring. This auger, driven by a simple coupling connected to the power take-off shaft of a Ferguson tractor, is capable of boring through rock, sandstone, limestone and quartzite. A hole of 7½in diameter has been bored through a concrete wall 10in thick. The accuracy of boring in homogeneous soils has been excellent, usually within 6in over 40/50ft. It is reported that on a recent test under good conditions a 7in diameter hole was bored at 3ft 6in depth under a new bitumen surfaced road in exactly 30 min. The length of bore was 35ft and the total time spent on the job was about 32 man-hours, including travelling, pipe laying and filling in, etc.

In the specialist field of cable laying could be classed the hydraulic plough method of laying submarine cables

as developed in Sweden. The Alnwich Harmstrorff method is one in which channels are blown in mud and loose rock by means of a plough ejecting water under pressure. The maximum cable-laying speed is roughly 90 cm per min, the actual channel depths range up to 5 m, dependent upon the nature of the sea bed. Laying is feasible in up to 50ft of water. A similar technique has been employed by the Japanese.

In the United States, using assembly line methods, it is claimed that street lighting cable can be laid in a sixth of the former time. The machine digs a trench 4½in wide and up to 40in deep and is sufficiently powered to plough through almost anything except solid rock. Cable drums are mounted on what looks like an inverted snow plough pulled backwards and sufficiently wide to collect all the spoil distributed on either side into the trench. A trailing air compressor assists in compacting the earth and provides air to two punners.

Acknowledgment is due to Clough Smith & Co., Ltd., the *Electrical World* (New York), W. T. Henley's Telegraph Works Co., Ltd., Pirelli-General Cable Works, Ltd., Rotary Hoes, Ltd., and the Eastern Electricity Board for permission to publish photographs and for information provided.

SCOTTISH TARIFF DISPUTE

A DISPUTE which originated in 1954 between the British Oxygen Co., Ltd. (predecessors of British Oxygen Gases, Ltd.), and the South West Scotland Electricity Board (predecessors of the South of Scotland Electricity Board) has again come before the Court of Session, Edinburgh.

The Second Division of the Court has given judgment upholding a decision of Lord Guest, who allowed a proof before answer in the action by British Oxygen Gases, Ltd., for payment of £9,995 against the South of Scotland Electricity Board, arising from a dispute over the method of charging for high voltage energy supplied to the company.

In December, 1954, the late Lord Hill Watson dismissed an action by the British Oxygen Co., Ltd., who had claimed payment of £10,000 in respect of alleged overcharges, it being alleged that the tariffs showed undue discrimination against high voltage consumers.

The company then appealed to the Second Division of the Court of Session, which, in June, 1955, allowed a proof. On the Board appealing to the House of Lords, the House in 1956 held the case relevant and remitted it to the Court of Session for proof.

Following this, the Board amended its defences and certain fresh matter was admitted to the case. This resulted in the action again going before the Court of Session and in May, 1957, Lord Hill Watson, after hearing a fresh legal debate, granted a declaration that the tariffs under which the Board had been charging the company showed undue discrimination against it, and he allowed a proof (see *Electrical Review*, 7th June, 1957, page 1058). The Board appealed to the Second Division against this decision, and proof in that action is still pending.

Meanwhile, in July, 1957, British Oxygen Gases, Ltd., a different company, although a wholly-owned subsidiary of the British Oxygen Co., took interdict proceedings before Lord Walker (*Electrical Review*, 19th July, 1957, page 123). His Lordship granted interim interdict against the South of Scotland Electricity Board's putting into effect a tariff which was, in the company's view, objectionable for similar reasons to the tariffs under dispute in the earlier action.

This interim order was afterwards withdrawn. This decision in turn was the subject of an appeal, but the Second Division upheld the recall of interim interdict.

The new action, for declarator and permanent interdict, came before Lord Guest, who heard a legal debate and allowed a proof. His judgment was appealed to the Second Division last month. The Division has now upheld the allowance of a proof before answer.

Lord Thomson, the Lord Justice-Clerk, giving his judgment, said this was "simply another round in the same old struggle." Nothing more could be said on the old points, which in due course would reach the House of Lords. Not only had both parties changed since 1954, but the statute which regulated the relationship between them had also been changed.

The earlier action had been concerned with three tariffs and the present proceedings with a fourth. The company said the fourth tariff was just another tariff on the same lines as the three others, and open to the same attack. Contesting this, the Board said the fourth tariff was on a different footing.

His Lordship said he was much impressed by the Board's argument that the company had not in its pleadings made it clear just in what precise way the vice which was built up in the original three tariffs was repeated in the fourth.

Lord Guest had accepted the argument for the defence on this point, but allowed the company to go to proof on its alternative case that, in any event, the fourth tariff, taken on its own merits, unduly discriminated against the company because it failed to maintain the differential to which the company was entitled.

It would serve no useful purpose to cut and carve on the extent of the proof in this case, said Lord Thomson, and might even complicate matters if, as appeared likely, the two cases were investigated together. Practical considerations seemed to point strongly towards letting the whole thing go into the melting pot.

Lords Patrick, Mackintosh, and Blades concurred.

AUSTRALIAN NEWS

From a Correspondent

THE Victorian State Electricity Commission's 5¼ per cent £2,600,000 loan has been undersubscribed by £985,250. Offers of 8, 9 and 10 per cent interest by private concerns make many of the lower interest offers unattractive to-day.

With the Australian economy slowing down, electricity production is also showing a decline in the rate of expansion. But in the electrical appliance field the output of various types of appliances continues to grow. Although Australian homes seem well supplied with vacuum cleaners, the November production was well up, and the total output for the year increased by no less than 53 per cent. Output of clothes washing machines in November was up by 20 per cent, and even the refrigerator field showed some brightening.

Imports into Australia in the financial year ended 30th June, 1957, included (with 1955-56 values in parentheses): Covered cable and wire, £778,791 (£1,904,355); batteries and accumulators, £409,396 (£387,929); communication equipment, £9,249,487 (£6,886,459); dynamo-electric machinery, £6,025,796 (£7,753,408); electric lamps, £1,568,231 (£1,648,938); heating and cooking appliances, £723,339 (£1,014,400); measuring and recording instruments, £951,107 (£1,490,491); transformers and rectifiers £3,706,976 (£3,654,078); circuit-breakers, £1,359,015 (£1,472,611); and alternators, £1,277,568 (£2,373,091).

Electronic Industries, Ltd., propose to buy an 86-acre site at Moorabbin for use as a new centre for the company's manufacturing activities, and a £500,000 office building in Melbourne is also planned.

Mr. J. R. Pillars, managing director of J. R. Pillars Pty., Ltd., Adelaide, has begun a five months' overseas tour during which he will visit Britain to investigate latest developments in power station and boiler construction.

COMMENTARY ON THE FORTHCOMING INSTRUMENTS, ELECTRONICS AND AUTOMATION EXHIBITION

New Techniques in Industry

By J. H. REYNER, B.Sc., M.I.E.E.

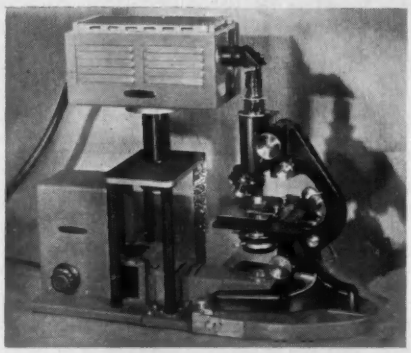
UP to about ten years ago the highlight of the scientific season was the Physical Society's Exhibition held annually in the spring. In one sense this is still true, but this Exhibition, by tradition and intent, is a display of new techniques, often only in an experimental stage, for the enlightenment of the scientific world. The situation has been changed, however, by the rapid translation of experimental techniques into practical production form. To-day it is possible to measure, and control, quantities and qualities which formerly were a matter of that inspired guesswork which is known as craftsmanship. One may perhaps deplore the passing of this craftsmanship in its older form, but the real fact is that it is being replaced by a different kind of craftsmanship more suited to the changing pattern of modern production requirements.

This changed emphasis led the scientific instrument industry to try the experiment of staging an exhibition devoted entirely to scientific instruments, including that very large section of the industry dealing with electronic methods and instrumentation. This proved an immediate success and what was intended to be a biennial function is now presented in an expanded form every year as the Instruments, Electronics and Automation Exhibition (I.E.A.) which is being held this year at Olympia from 16th to 25th April.

The reason for this popularity is not far to seek, for the range of the exhibits is almost bewildering, and it confirms clearly that the pattern of industry is changing. The I.E.A. Exhibition, in fact, is not merely of interest to workers in the scientific instrument field, but it has an altogether wider appeal, not only in this country but abroad. Indeed, British instrumentation makes a substantial contribution to the export market.

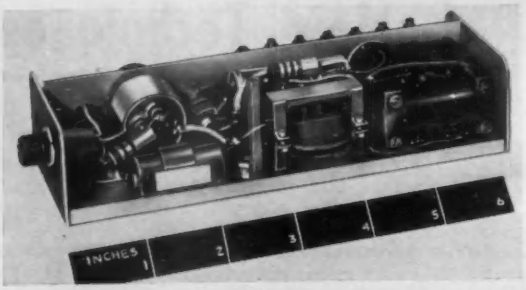
A broad survey of the exhibits in this year's exhibition shows a continued improvement in the facilities offered. In the field of instrumentation the developments are mainly in the direction of increased range of performance. This is shown in two directions; first, in increased precision in existing equipment such as optical and mechanical apparatus, and secondly in the extension of the field of measurement beyond formerly accepted limits. The increasing use of servo techniques, for example, has resulted in the production of generators and measuring instruments capable of dealing with signals of extremely low frequency occupying several seconds per cycle. Dawe Instruments, for example, are exhibiting an oscillator which provides two outputs in quadrature over a frequency range of 0·1 to 10,000 c/s, while several firms offer valve voltmeters capable of measuring both the in-phase and quadrature components of a signal.

Jumping some twenty or more octaves we come into the supersonic range where techniques involving mechanical vibrations of the order of 50,000 c/s are finding increasing applications in the direction of cleaning, drilling irregularly-shaped holes and echo techniques of various forms. The use of supersonic echoes for the detection of flaws and cracks in materials is now in common use. An interesting variant of this technique is the Sperry "Introview" flaw and corrosion detector, which has been designed specifically for the non-destructive testing of metal tubes as used in normally inaccessible assemblies such as condensers and heat exchangers. A slim probe is drawn through the tube by an electrically-driven winch. This probe carries coils whose characteristics are modified by the proximity of the metal tube. The output is recorded on a chart moving in corre-



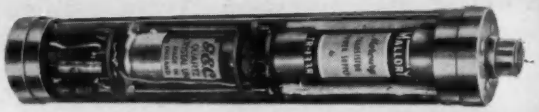
TV camera coupled to a microscope using ultra-violet illumination

This illustration shows an "Introview" survey being carried out on a steam condenser

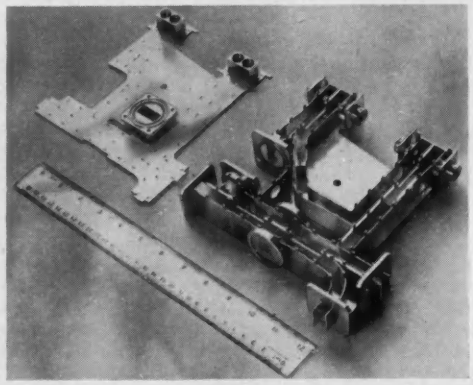


This d.c. transistor invertor operates fluorescent lighting for transport from completely static equipment

The "Gamma Switch" which is operated from gamma rays is an alternative to the photo-electric cell



Quartz-crystal transistor oscillators are now available in packaged form and are of great assistance to electronic equipment designers



Partly assembled dip-brazed aluminium waveguide

spondence with the probe and as long as the tube is sound the record is substantially constant. Any flaw or corrosion, however, produces a distinctive disturbance of the trace, indicating not only the nature but the position of the defect. Routine inspection can thus be carried out without having to dismantle the condenser and one can indeed regard this equipment as typical of the manner in which electronics is able to provide real service to industry.

Television in Industry

Closed-circuit television is also finding increasing applications to industry. There are many occasions where it is impracticable to view a process directly due perhaps to danger, inaccessibility or inconvenience, and several such applications are being shown by Pye. The system has been used in traffic control, providing a picture of the conditions at one or more vital points outside the immediate view of the controller. It has been used to televise operations from a medical theatre enabling the procedure to be viewed in a remote lecture room with much greater detail, yet leaving the surgeons complete freedom of access, while the use of underwater television cameras is now well known.

Apart from these obvious uses, however, there is the fact that the television camera can be made sensitive to different wavelengths of light. The resolution of a microscope, for example, is determined by the wavelength of the light used. By using ultra-violet light in conjunction with a television camera sensitive to this (invisible) light appreciably improved resolution can be obtained, while the received image is translated into the visible range and can therefore be observed by eye. Moreover, if living cells are being examined the process is not destructive, which is a great advance in the medical sphere.

There is continued development in the use of pulse techniques, particularly in the radar and microwave fields. Generators and oscilloscopes handling millimicrosec pulses are now in normal production. A development of interest is in improved methods of achieving the high precision required in the construction of waveguides which will reduce the cost of radar equipment and may lead to unforeseen uses of this technique in industry, apart from navigational uses.

In the electronic field, however, the most striking advances are probably in the increasing use of transistors, which are not only becoming suitable for increasingly high frequencies but also increasing power outputs, and many devices which formerly required the use of valves with the necessarily bulky power supply are now being achieved by transistors within very much smaller compass and greater reliability. One example, shown by the G.E.C., is a unit providing the relatively high voltage required for fluorescent lighting from the normal low-voltage d.c. battery.

There are also a number of applications of nucleonic techniques to industry. One typical example is the "Gamma Switch" made by Isotope Developments, Ltd. This is a device which is sensitive to gamma rays in the same way as a photocell is sensitive to light. It can therefore be used in association with a suitable source of gamma rays to determine changes of level or density, etc., based on the varying absorption of the rays by the sample on test.

Electronic Calculators

Finally, there is the whole field of computer techniques. One is accustomed to think of computers in terms of the very large and expensive installations constructed by research establishments (and Manchester University in particular), but electronic calculators of various types are becoming standard equipment in many large organisations. The British Tabulating Machine Co., for example, has supplied over 600 Hollerith electronic calculators, and a battery of these machines regularly undertakes the pay calculations of 80,000 employees of London Transport.

Various firms are exhibiting the use of computer techniques, not only for calculating, but for the programming of processes and the control of the operations of machinery of all types by breaking down the operations into a series of commands of a "yes-or-no" nature and co-ordinating these into a programme which can then be recorded on punched tape.

The Elliott Automation Group will be exhibiting examples of this, including a display showing the co-ordination of information obtained remotely from various portions of a complete process, while the English Electric Co. will have a working model of a hot reversing type rolling mill with automatic programming equipment.

These few examples, of course, are merely indications of the general trend of development which will be in evidence at the Exhibition. As was said earlier, instrumentation and electronics are no longer new-fangled ideas but an intrinsic part of modern production, as a visit to the I.E.A. will very clearly demonstrate.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Power Station Managers

REFERRING to the suggestion made by "Engineer-Manager" in your issue of 21st March, it may interest your correspondent to hear that in our company, one of the largest electricity supply concerns of this country, the head of each one our power stations, who is always a university graduate, is called "Ingénieur-Directeur de Centrale."

This is the translation of "Power Station Engineer and Manager," as suggested by your correspondent. We too believe that the technical aspect of the function should be reflected in the title.

Brussels, Belgium. A. WUST, M.I.E.E.,
General Manager,
Sociétés Reunies d'Energie du Bassin de l'Escaut (E.B.E.S.).

Off-peak Heating

MR. A. C. HAZEL'S suggestions are to be encouraged, if only for the fact that they will cultivate an appreciation of the value of space heating in this country where standards, particularly in private houses, are deplorably low. Owing to our fickle climate it is difficult to be dogmatic about any particular system, and we must encourage enterprising people who are interested in this particular sphere of work.

It is significant that in countries which have cold climates, such as Canada and the Scandinavian countries, a great deal of the space heating is from oil-fired furnaces with hot water systems. There may, of course, be many reasons for this, but experience has shown that in this country electric off-peak heating can be and is very successful. "Nightstor" heaters are being used with great success in many commercial and business premises, and under-floor electric heating is proving to be successful and satisfactory in domestic premises.

I am not able to provide comparative costs between under-floor heating and electric convectors or radiators, but I can give an example which is characteristic of residences with which I am acquainted. A house completed in January, 1957, has an under-floor heating load of 8·5 kW and a ground floor area of approximately 700 sq ft. The floor is finished in concrete, and with the exception of the kitchen, covered with fitted carpets. The aim of the occupier is to maintain comfortable conditions throughout the area of the ground floor, but not a temperature of, say, 65 deg F, which would obviate other forms of heating. He does use an open type coal fire in his lounge, but this is the only additional heating used in the ground floor rooms.

Satisfactory charging periods have been found to be from midnight to 7 a.m. and, in very cold weather, an afternoon boost from 1.30 to 3.30 p.m. Thermostatic control is installed and this will, of course, vary the unit consumption from week to week throughout the winter. The mass of heat rising from the heated floor appears to cope effectively with window draughts which seem to cause Mr. Hazel some concern. Where this form of heating is used there would appear to be no need for the installation of particularly placed apparatus to deal with this problem.

Elton, Peterborough. L. HOULDRIDGE.

Intrinsically Safe Apparatus

THE principal feature of the latest edition of B.S. 1259 is the introduction of a list of inflammable gases and vapours in respect of which apparatus may be accepted for test and possible subsequent certification. These gases and vapours are placed in four classes (methane, pentane, ethylene and hydrogen) for the purposes of tests which are described in an appendix.

The Standard specifies general requirements for all types of electrical equipments which may be regarded as being safe for use in dangerous explosive atmospheres (such as in coal mines, oil and petroleum stores and in industry generally) by virtue of their electrical design and circuit characteristics, as opposed to equipment in a flameproof enclosure, for which the Standard is B.S. 229.

The term "intrinsically safe," as applied to electric circuits and apparatus is defined, and the Standard includes information and requirements relating to the certification of equipment so described. Three appendices provide much useful information on the principles and tests for intrinsic safety, together with a full list of references to technical reports and publications issued by the Electrical Research Association and the Safety in Mines Research Establishment.

Copies of B.S. 1259 : 1958 may be obtained from the British Standards Institution, 2, Park Street, W.1, price 4s.

Direct Power from Heat

A MACHINE which can convert heat directly to electricity has been made by two professors at the Massachusetts Institute of Technology. This thermo-electron engine consists of a vacuum tube containing two plates, one relatively hot, the other relatively cold. Electrons are emitted from the hot plate and collected on the cold plate. It is claimed that the present machine has an efficiency of about 12 per cent, but it is hoped that efficiencies of 30 per cent will be obtained in the future. It is also stated that an efficient machine could be built to give 5,000 to 15,000 W per cu ft of plant volume.

National or Local Wage Rates?

INDUSTRIAL DISPUTES TRIBUNAL DECISION

THE Industrial Disputes Tribunal recently issued its award in a case put before them by members of the National Federated Electrical Association and workers (Electrical Trades Union members) employed by them (Award No. 1,069, H.M. Stationery Office, 8d). It was claimed by the workers that Clause 8 of the National Working Rules for the Electrical Contracting Industry should be amended. As it stands, this clause stipulates the payment of the agreed rate under the National Standardised Wages Agreement of 1920 for fully-qualified journeymen electricians, and that if operatives of other trades are employed the rates applicable to those operatives shall be observed. The clause recognises the payment of more than the standard rate to any employees with special ability or long service and also to those selected to undertake work calling for "unusual physical ability."

Union's Proposal

The Union's proposed amendment would have had the effect of stipulating that the rates should be as determined from time to time by the National Joint Industrial Council and should be considered as minimum rates. It also sought to add to those to whom higher rates could be paid "employees on particular jobs involving special conditions not normally experienced in the electrical contracting industry, or on jobs where other trades are in receipt of extra payments because of lieu payments, or the operation of payment-by-result schemes."

In support of this the Union argued that the difficulties at present existing in the industry might be resolved by the introduction of a greater measure of flexibility which would permit negotiations to take place locally or on the sites.

The "difficulties" referred to appeared to arise mainly from the fact (as stated by the Union) that on many sites operatives employed in other trades which had payment-by-results and incentive schemes had rates of pay that were higher than those received by electricians working with them. In some cases this was true of labourers working on a site, and trouble was bound to arise when skilled craftsmen found themselves in such a position. It was pointed out that in two cases—Calder Hall and Shellhaven—negotiations between the contractors, the N.F.E.A. and the E.T.U. had resulted in the payment of rates in addition to the agreed standard rates.

N.F.E.A. Reply

For the N.F.E.A. it was stated that the Union's motives for putting the claim forward were (1) the existence of a payment-by-results scheme in the building industry; (2) to secure throughout the country the right to obtain the highest possible wage rates for its members and to withhold labour until acceptable wage rates were obtained from employers seeking additional labour; and (3) the creation of a precedent which would have immediate repercussions in the constructional industries group and in the nationalised electricity supply industry. The Association maintained that the claim was in effect for an increase in wages based on the abandonment of the well-tried system of standard rates and its replacement by minimum rates with additional site payments, a form of agreement which would be quite unsuitable to the industry.

The Association outlined the conditions prevailing in the building industry since the war, which had necessitated the introduction of payment-by-results schemes but, it said, conditions had now so altered that excess payments were tending to diminish and the Union's claim, in so far as it relied on these excess payments, would therefore disappear. Both sides of the electrical contracting industry had found that a payment-by-results scheme would be impracticable. It was also contended that the great majority of the employees were satisfied with the present terms and conditions; only a very small percentage of sites and only about 500 operatives had been affected by the disputes referred to.

Moreover, it was said, there was no evidence that production in the industry was increasing; it was still below the pre-war level. If conceded, the claim would increase the cost of installation work and affect many workers outside the industry. Standard rates were necessary to enable contractors to quote on terms similar to those quoted by the electricity supply industry.

Having carefully considered the statements and submissions of the two parties, the Tribunal found that the claim had not been established and awarded accordingly.

British Standards Year Book

MORE than three thousand British Standards were issued between the foundation of the British Standards Institution in 1901 and the end of last year. This fact emerges from the recently published B.S.I. Yearbook for 1958, which includes a numerical list and brief descriptions of all Standards current on 31st December, 1957.

With this and a wealth of other information the yearbook is the only available reference book to British Standards, and as such it is of great value to every user of them. Apart from British Standards and Codes of Practice, the 520-page book also lists the publications issued by the International Organisation for Standardisation (I.S.O.), the International Electrotechnical Commission (I.E.C.) and the International Commission on Rules for the Approval of Electrical Equipment (C.E.E.); these publications are all available for purchase from the B.S.I.'s Sales Branch. Other sections of the book detail a number of B.S.I. services, from the list of industries for which "sectional lists" of current Standards are published to the "approval services" provided for United Kingdom manufacturers who export to Canada. There is also a comprehensive index in which all British Standards are listed according to their subjects.

One free copy of the yearbook has been sent to all the subscribing members of B.S.I.—now totalling some 10,000 commercial firms, professional and trade associations, local authorities and individuals. The book is also available for purchase at 15s plus 1s 6d postage and packing from the British Standards Institution, 2, Park Street, London, W.1.

SILICONE INSULATED TRACTION MOTORS

Experimental Work by London Transport

A COMPREHENSIVE programme of experiments is being carried out by London Transport in the use of silicone materials in place of mica based materials for the insulation of armature windings of traction motors and other equipment on the London Underground rolling stock. It is hoped that the experiments will yield important results in prolonging the life of armatures, giving the motors improved performance and reliability and economy of maintenance, and eventually in permitting reductions in the weight and the cost.

Most failures in traction motors arise from the thermal ageing of the insulation which leads to carbonisation and tracking. Silicone materials have been found to possess a more stable chemical structure than mica and other organic insulating materials, and their decomposition, when it takes place, leaves no electrically conducting products. They are better able to withstand elevated temperatures and are less liable to thermal ageing. Their use appears, subject to large-scale experience under actual running conditions, to offer substantial advantages in the general efficiency of traction motors. The ability of silicone insulation to withstand high temperatures may also permit a reduction in the size of a machine for a given output by enabling it to be run closer to the limit of its rating.

Experiments with silicone insulation in the form of taping and wrappers have been carried out by London Transport over a ten-year period and considerable advances have been achieved in their practical application to traction motor insulation. A number of traction motors insulated with silicone materials have been run for lengthy periods. During the experiments, steps were taken to provide abnormally arduous conditions with temperatures much higher than those at which motors normally run. The results have been encouraging.

It has now been decided that a proportion of traction motors on new Underground rolling stock will be insulated with silicone materials and their performance will be studied in comparison with that of those insulated with the materials formerly standard. In addition, Metadyne machines used for traction control purposes in certain types of rolling stock are now all being rewound with silicone materials whenever this work becomes necessary.

In 1948 development work was started at the central railway overhaul works of London Transport to produce a satisfactory silicone insulated traction motor. The primary object of the test was to develop an improved form of insulation for existing and future traction motors and other rotating machines. At the same time experience would be gained in the special production techniques which might be needed with these almost untried materials.

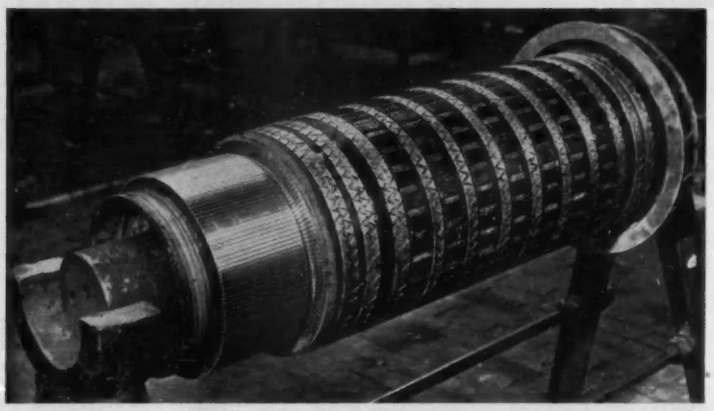
The suitability of silicone materials as insulators at temperatures in excess of those permitted for Class "B" insulation showed the possibility of improving motor performance either by increasing the life of the armature windings or by obtaining a higher rating from an existing machine. A successful conclusion to the tests would also have its effect on the design of new traction motors.

Extensive work on the organic chemistry of silicon was carried out by Professor F. S. Kipping at Nottingham University from about 1896 onwards, but commercial development of silicones as we know them to-day was delayed until during the last war, since when an increasing number of industrial applications have been found for them. This growth has been accompanied by great improvements in the properties of silicone materials themselves. A "silicone" is a silicon-organic compound based on a silicon-oxygen structure with hydrocarbon radicals bonded to the silicon atoms. Silicones can take many forms, but for electrical purposes the most important are the silicone resins and elastomers. These materials have similar properties to their organic equivalents, but they show a great chemical stability which makes them better able to maintain their properties over a wide temperature range. It is this feature which makes them of value as insulators for electrical machines.

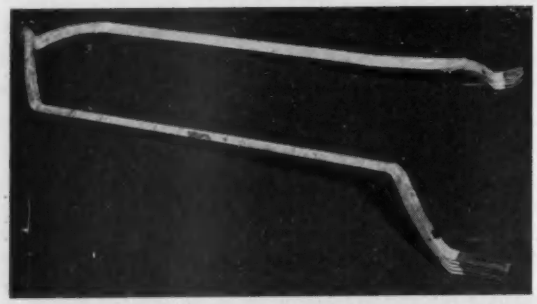
Type of Motor Chosen

The traction motor selected for tests with silicone insulating materials was the LT.100 type. This machine, which was designed in 1938, is basically similar to the traction motors being designed to-day, and was chosen because of the large number in service. The motor is a 168 h.p. (one hour rating) 600 V four-pole machine. It has 31 armature slots, five conductors to each slot and is wave wound. The armature slot space factor is higher in this motor than in any other in service on London Transport's railways, and this fact ensured that if silicone insulating materials were satisfactory on this type of machine, it would be possible to use them on others with a lower armature slot space factor.

When the tests were started the only silicone compounds suitable for motor insulation were the silicone resins which could be used in place of organic varnishes in combination with woven glass and mica. For this



An LT.100 traction motor armature insulated with silicone bonded glass mica. This armature is shown with the ventilating fan fitted



Traction motor armature bar insulated with silicone bonded glass mica tapes

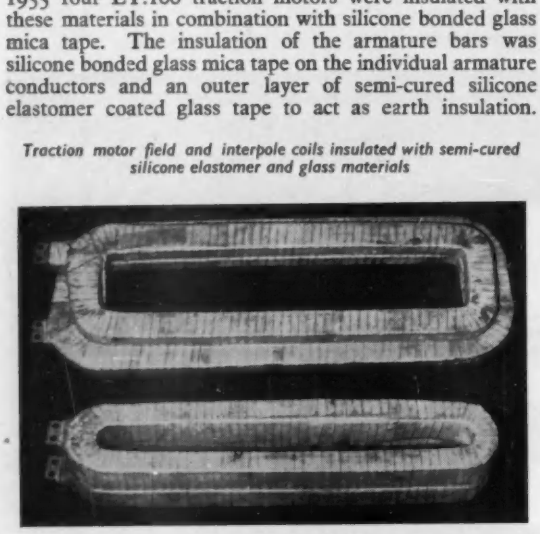
reason the method of insulating the first motor for test was to substitute woven glass tape and silicone varnish for the paper and shellac which were used in the existing scheme of insulation. Three of the armature conductors were insulated with a half-lapped layer of glass mica tape bonded with silicone varnish, but to obtain the required armature bar dimensions it was only possible to apply a butted layer on the remaining two. The earth insulation consisted of silicone bonded glass mica tape wrapped round all the conductors and this was retained by a half-lapped layer of white glass tape. At each stage of insulation the armature bar was painted with silicone varnish and finally it was treated in a hot press to cure the varnish.

The use of the hot press introduced production difficulties, which led to the abandoning of this method of insulation in favour of further tests on the then newly introduced silicone elastomers. One motor, however, was insulated in this manner and entered service in November, 1952. In December, 1953, it was withdrawn because the ventilating fan had been damaged and the opportunity was taken to return it to service without the fan so that the running temperature would be raised. This motor is still running in this condition and no defect has developed.

Use of Semi-Cured Silicone Elastomer

During 1952 semi-cured silicone elastomer materials were introduced into this country, and between 1953 and 1955 four LT.100 traction motors were insulated with these materials in combination with silicone bonded glass mica tape. The insulation of the armature bars was silicone bonded glass mica tape on the individual armature conductors and an outer layer of semi-cured silicone elastomer coated glass tape to act as earth insulation.

Traction motor field and interpole coils insulated with semi-cured silicone elastomer and glass materials



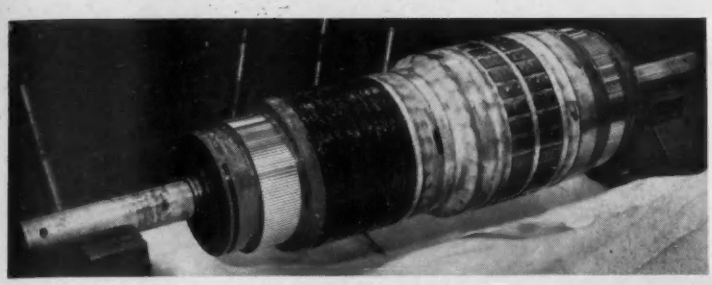
This semi-cured elastomer was later cured in an oven to bond the layers of tape to form a sheath round the armature bar. The armature bar was completed by an outer wrapping of white glass tape which was afterwards covered with a silicone varnish. Two of these machines were also fitted with field coils insulated with silicone bonded flexible mica between the turns of the coil, and an outer wrap of semi-cured silicone elastomer coated glass tape, covered with a layer of white glass tape and finished with a coat of silicone varnish. The running temperatures of these two machines were raised by omitting the ventilating fan and blocking the armature core ventilation ducts.

During manufacture of these armature bars it was found that on occasions the silicone elastomer failed to cure. Silicone elastomers require very careful temperature control during the curing operation, the later stages of which must be carried out in the presence of oxygen, otherwise the cure will be inhibited. It is necessary to use a two-temperature curing cycle—first, at a lower temperature to initiate the cure and then at a higher temperature to complete the cure. If too high a temperature is used too soon, bubbling and sponging may occur. As some of the semi-cured materials are also sensitive to contamination by organic substances, it will be seen that their use presents production problems which are difficult to overcome without special equipment.

Early in 1956, one of the four machines which was insulated with a combination of glass mica tape and silicone elastomer failed with an armature insulation defect. Examination of the machine indicated that in spite of the severe arcing which had taken place at the point of failure, the surrounding insulation remained in good condition and showed no sign of carbonisation under the intense heat. Examination of the undamaged armature bars showed that the silicone elastomer had failed fully to cure, with a result that when the armature bar was fitted into the armature slot the silicone rubber had been reduced in thickness at the bottom corners. In addition, there were indentations in the silicone rubber under the banding wire, due to the localised pressure at these points. It was considered that the reduction in the thickness of insulation at certain points, due to the plasticity of the incompletely cured silicone elastomer, was the cause of the failure and it was decided that the use of semi-cured silicone elastomer should be abandoned because of the difficulty of ensuring a proper cure under production conditions. Development work was therefore concentrated on the use of fully cured silicone elastomer tapes for the armature bar insulation. The remaining three machines which were insulated with semi-cured elastomer are still running satisfactorily.

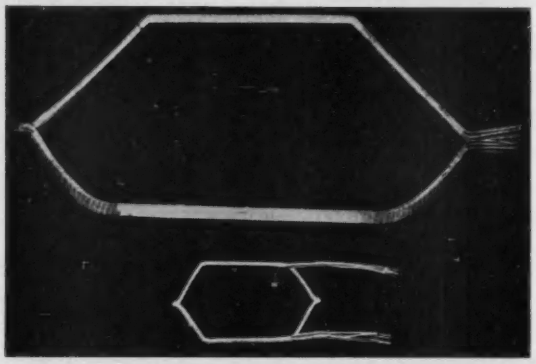
By this time silicone adhesives were available and a fully cured silicone elastomer impregnated glass tape was developed which was coated with a thermosetting pressure-sensitive silicone adhesive. A tape having the desired electrical and mechanical characteristics was produced as thin as 0·006in and it was thought that this would be more suitable than glass mica tape for the insulation of the individual armature conductors. With glass mica insulation on the armature conductors there is a risk of the mica splittings fracturing at the sharp bends on the edges of the conductor, which reduces the dielectric strength of the conductor insulation at these points. By using a silicone elastomer tape, which is flexible and homogeneous, these difficulties are overcome and, in addition, the resilience of this insulation resists damage by vibrational and other stresses occurring in service.

As the minimum thickness of the silicone elastomer glass tape was greater than the thickness of the glass mica



A Metadyne regulator and exciter armature. The regulator, which is insulated with silicone varnish bonded glass and mica, is the further of the two armatures

A Metadyne exciter and a main armature coil, both of which are insulated with silicone materials. The silicone elastomer earth insulation can be clearly seen on the slot section of the main armature coil



tapes used for the armature conductor insulation it was only possible to insulate three of the five armature conductors, the remaining two being left bare. The earth insulation consisted of two half-lapped layers of silicone elastomer glass tape coated with a pressure-sensitive silicone adhesive, and finally a half-lapped layer of white glass tape varnished with a silicone varnish. An armature insulated with this coil insulation entered service in the middle of 1957.

A number of armature bars which were insulated in this way were submitted to laboratory tests which were designed to simulate the effects of centrifugal force and temperature. These tests, which were carried out in conjunction with Midland Silicones, Ltd., and H. D. Symons & Co., Ltd., indicated that the bars were well able to withstand the mechanical stresses likely to be encountered under operating conditions. They were also heated to 200 deg C for nine days and then to 330 deg C for 25 hours. No adverse effects could be detected as a result of this heating cycle.

Breakdown Voltage to Earth

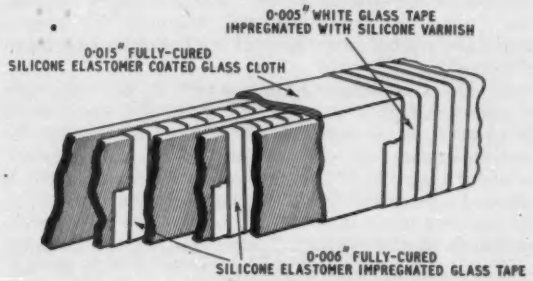
Under the high-voltage test it was found that breakdown of this system of insulation occurred to earth as a result of tracking across the adhesive layer. For this reason, and to utilise the available space in the armature slot to its full extent, it was decided to substitute a fully cured silicone elastomer impregnated glass wrapper for the tape which was previously used for earth insulation. This alteration more than doubled the breakdown voltage to earth. It means, however, that only two of the armature conductors can be insulated, leaving three bare. Twelve LT.100 traction motor armatures are being insulated in this way and, in order to distribute the pressure under the banding wire more evenly and to prevent local indentation of the insulation, strips of epoxy resin glass laminate are to be inserted between the armature bars and the armature bands. It may be possible, however, to obviate the use of the epoxy resin bonded glass laminate by the substitution of polyester resin bonded glass rovings for steel banding wire.

While experiments were being carried out with the LT.100 traction motor, it became necessary to rewind a number of Metadyne machines, which are used for traction control purposes on certain types of rolling stock, and more than 50 of these machines have now been rewound with silicone insulation. At the time the decision was taken to use these materials, it was thought that the semi-cured silicone elastomers would give satisfactory service, and an armature bar was therefore developed using this material in combination with glass mica tape. In fact, this armature bar has given good service, in spite of the silicone elastomer failing to cure on occasions, because the armature has a tapered slot and slot wedges are used in place of banding, so that there is less tendency for the elastomer to be displaced under pressure.

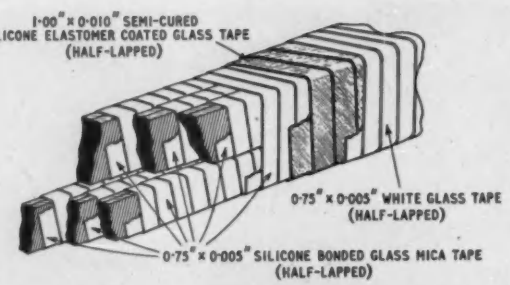
Under fault conditions, this type of machine can overheat and failures have occurred due to the solder melting in the commutator risers. No damage appears to have occurred to the silicone insulation under these conditions and a solder with a higher melting point is now used to prevent a recurrence of failure due to this cause. High-temperature solder is also used on traction motors.

The Metadyne machine also incorporates an auxiliary machine, known as a regulator, which is used for speed control purposes. This machine is of a wire-wound type and under fault conditions this also may overheat. It is now the standard practice to rewind the regulator with silicone materials, using glass-covered wire bonded with the silicone varnish. The earth insulation is silicone bonded glass mica and the complete coil is impregnated with a silicone varnish.

The varnish used for impregnation is not a true silicone varnish, but one modified by co-polymerisation with an alkyd resin. The modified silicone varnishes are valuable for many applications where resistance to oils and solvents and high bond strength are important. Although the modified silicone varnishes have a maximum operating temperature lower than that of a true silicone varnish, and they do not possess the advantage of leaving a non-



Sectionalised view of the slot section of an LT.100 motor armature bar insulated with fully cured silicone elastomer glass tapes and slot wrapper



Sectionalised view of the slot section of a Metadyne machine armature bar insulated with silicone bonded glass mica tapes and semi-cured silicone elastomer

carbonaceous residue on decomposition, they are useful when rewinding machines which have to endure intermittent overloading rather than sustained operation at elevated temperatures.

London Transport has had some ten years' experience in the use of silicone insulating materials for traction motors and is now proposing to specify their use on a fair proportion of traction motors being provided for new rolling stock. Their use is already specified for insulation when rewinding Metadyne machines.

Silicone materials are more expensive than the equivalent organic compounds, but it is not possible to generalise about costs for all types of machine. In the case of the LT.100 traction motor, the additional cost of insulating the armature with silicone materials is less than five per cent of the total cost of rewinding the machine and this increase in cost can be justified if longer armature life can be obtained. Laboratory and accelerated tests, in fact, indicate that silicones show greater freedom from ageing than organic materials, but none of these tests can reproduce exactly the conditions encountered in a traction motor. The proof of these materials must therefore be under service conditions over a longer period than has so far been available for trials.

Because silicones are suitable for work at an elevated temperature, advantage can be taken of this property to reduce the size of a machine for a given output. This is useful in traction applications where weight and size are important, and the smaller machine should also be cheaper in first cost. The traction motor designer may be tempted to use the new rating to the limit, while the user of the machine would prefer to see some of the potential up-rating absorbed in improving the slot space factor, and therefore reliability, at the expense of a larger machine. The conflict may be resolved in a compromise, possibly in the form of a totally enclosed machine of the same dimensions as the existing ventilated machines.

Extension and prolongation of these tests is still necessary, in order to confirm that improved performance and economy in maintenance can be achieved by the use of flexible insulating materials in place of mica.

Leipzig Spring Fair

FROM A CORRESPONDENT

SINCE its resumption after the war the Leipzig Fair appears to have settled down to a pattern of its own in respect of the nature, and the principal countries of origin of the exhibits on show, and the organisation and the administration of the Fair itself. Compared with the previous year, the Spring Fair which was held from 2nd to 3rd March this year showed perhaps more improvement in the art of organising the Fair than in the range and design of the technical equipment on show, although there were some interesting novelties. Goodwill towards British exhibitors and visitors and the desire to improve trade relations between the East German Republic and Great Britain was very noticeable.

According to an official announcement, 48 different countries participated in the Fair, but only a much smaller number exhibited on any appreciable scale. Most prominent amongst these was, next to the host country, the Federal German Republic, although the largest national pavilions were those of the U.S.S.R., China and Czechoslovakia.

Electrical equipment again occupied an important part of the exhibition space at the Fair, and represented all aspects of electrical engineering. Instruments for nuclear applications, made in Eastern Germany, covered a wider range than on previous occasions and models showed experimental nuclear reactors, either in operation or under construction in that country, as well as the buildings of the Nuclear Science Institute at Dresden. High-voltage porcelain insulators were of high quality; those for use on transmission lines were representative of the general tendency in Germany and other countries to employ long rod-type insulators practically to the exclusion of the cap-and-pin and kindred types. Special designs have been developed for use in areas with a high degree of air pollution.

The East German economy suffers from an acute shortage of copper which is reflected in the extensive use of aluminium in electrical engineering. Aluminium-cored underground cables are very common and by a standing Government regulation all except the very largest transformers must be manufactured with aluminium windings, unless a special dispensation is obtained from the Government by the prospective user. Not one bulk oil volume circuit-breaker of any description was seen, all those exhibited being either of the small oil volume, air-blast or, in the smaller sizes, sometimes also hard gas types. Models of large power station plant, mainly from Eastern and Western Germany, indicated conventional designs, and such parts as were actually exhibited, including forgings for turbo-alternator rotors, steam turbine rotors and other machines, were of a high standard of design and workmanship.

Dewatering Fine Coal

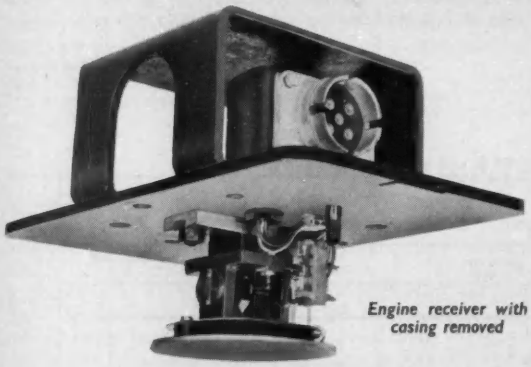
IN a paper presented before the Institute of Fuel on 20th March, Dr. V. R. Gray (formerly National Coal Board, now Timber Development Association) described a new laboratory technique for investigating the removal of water from fine coal. It consists of applying increments of suction to the saturated coal bed and measuring the moisture removal at each equilibrium for each increment. The mean pore size of the coal bed is closely related to the proportion of fine coal, above a certain value of which it reaches a constant value.

Automatic Train Control

British Railways Standard System*

ON the formation of British Railways in 1948, two systems of automatic train control (A.T.C.) were in operation, one covering the principal routes of the Great Western Railway and the other on the London, Tilbury and Southend section of the London, Midland & Scottish Railway. Both were associated with "distant" signals of the semaphore type and gave a warning in the cab of a locomotive when approaching one of these signals showing "caution." The "caution" warning in semaphore signalling tells a driver to be prepared to stop at the next signal and is conveyed at night by a single yellow light. Where colour-light signalling is used, an earlier warning may be given in the form of two yellow lights, meaning that the next signal is showing a single yellow and the one after that a red. A demonstration was given in 1949 of G.W.R. cab equipment modified to give an additional indication corresponding to this "double-yellow" aspect, but the modification has not been adopted.

In 1951 the Railway Executive decided to set up a committee to develop a system of automatic train control for future use on British Railways, stipulating, among other requirements, that the link between track and vehicle should be inductive instead of by any form of physical contact. Development has now reached the stage at which it is possible to undertake a programme of extending to York the existing trial installation on the east coast main line between King's Cross and Grantham, and installing similar equipment from Euston to Blisworth and from Edinburgh to Glasgow. Details of the mileages involved and the quantities of equipment ordered were given in the *Electrical Review* of 21st February.



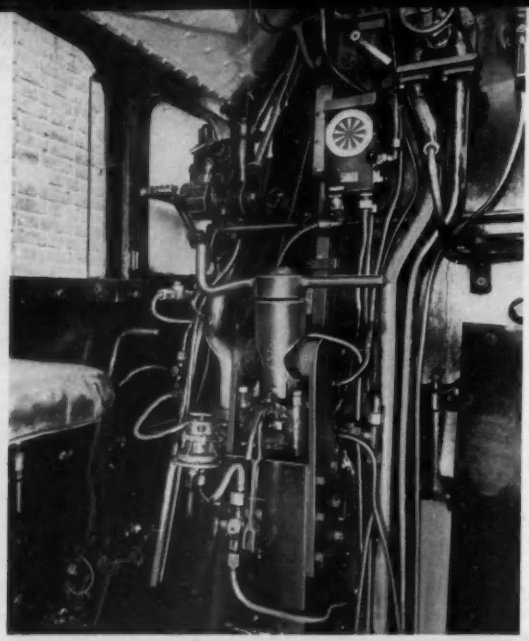
Engine receiver with casing removed

The apparatus now adopted uses a magnetic link similar to that of the Hudd system described in the *Electrical Review* of 17th January, but instead of the locomotive receiver acting directly on the vacuum brake system, it does so through electrical circuits, and in this way it has been possible to give a bell signal in the cab for "all clear" instead of the short siren note provided in the Hudd system when air is admitted to the brake gear on passing over the first (permanent) magnet and cut off on passing over an energised electromagnet some 15 yd further on. The spacing of the magnets for this purpose is no longer necessary, and they have now been closed up together and are contained in a single housing. Re-design of the magnets to allow vertical mounting instead of the horizontal arrangement of the Hudd system was undertaken by the Permanent Magnet Association of Sheffield. Although the volume of magnetic material in the present inductors is less than one-fifth of that in the Hudd type, they are appreciably more powerful, operating through a 5in air gap as compared with 4in for the Hudd magnets.

Close-up of engine receiver passing over track inductors

The permanent magnet inductor, electromagnet inductor and a protecting steel ramp are fixed in the centre of the track about 200 yd on the approach side of distant signals in semaphore-signalled areas, or of all signals in colour-light areas, since every colour-light signal can give a "caution" indication corresponding to that of a semaphore "distant" signal. The permanent magnet inductor is a vertical magnet of Alcomax II, 5in high, with a cross-section of approximately 9 sq in, and is fitted with steel spreader plates 10in long by 5in wide at top and bottom. It is mounted with its south pole uppermost. Although of similarly shaped magnetic structure, the electromagnet inductor has a Swedish iron type centre core and is considerably longer. To compensate for this, and to achieve a similar flux curve to that of the permanent magnet inductor, the two ends of the lower spreader plate are bent upwards. There are two windings on the core, which may be connected in series or parallel for 24 V or 12 V operation. Power consumption is 9 W. The supply may be taken from a rectifier, from trickle-charged secondary cells, or from primary cells. In the latter case the inductor may not be energised as soon as the signal goes to "clear,"

* Based on a paper to the Institution of Railway Signal Engineers by Mr. J. H. Currey, Signals and Communications Development Engineer, British Railways Central Staff.



Driver's control unit showing indicator (after caution signal) and flexible cable coupling

but the drain on the battery may be reduced by not connecting it until an approaching train occupies a particular track circuit. The inductor is wound so as to present a north pole to the locomotive receiver. Both inductors are installed with their tops at rail level.

The receiver now being fitted to steam locomotives consists of a small permanent magnet pivoted between soft iron laminated pole pieces, which are in magnetic contact with iron collector plates (a 5in diameter lower plate and a top plate measuring 16in by 10in). A coil is wound round the lower pole piece to magnetise this and so reset the receiver armature when required. The receiver is fixed below the locomotive with the bottom of its non-magnetic cast-iron enclosure 5in above rail level. Oscillograph records indicate that the maximum speed for satisfactory operation would be over 150 m.p.h.

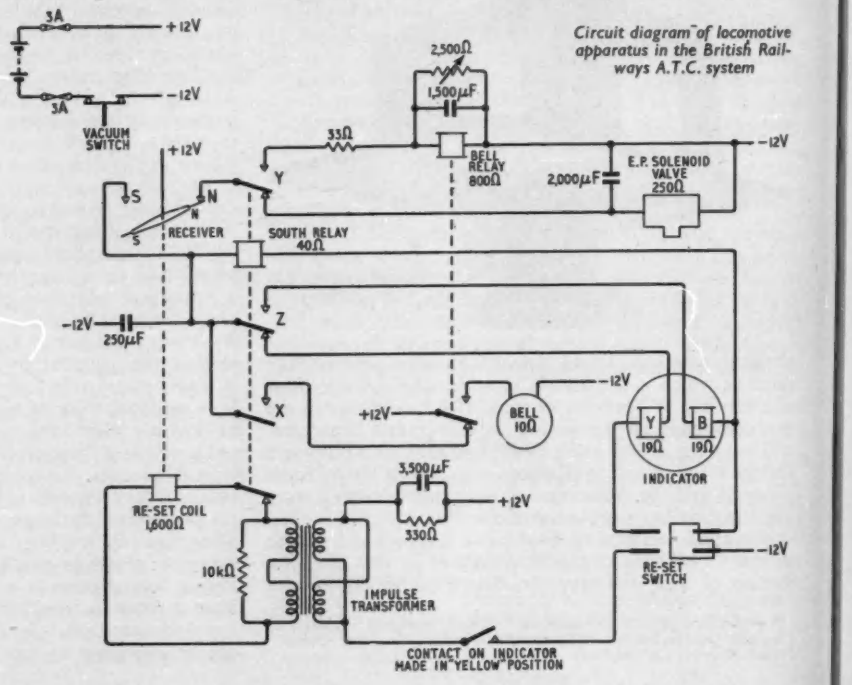
The operation of the locomotive electrical circuits can be followed in the accompanying diagram. Here the receiver armature is shown in its normal position, with its north contact made, so that the 12 V, 32 Ah NIFE battery energises the solenoid of the electropneumatic valve communicating with the train pipe of the vacuum brake system. The valve is therefore held closed, and the 2,000 μF capacitor is charged. A vacuum switch is included in the battery circuit as an economiser, serving to isolate the battery when the locomotive is out of service and the vacuum is no longer being maintained.

On passing over the track inductors, the receiver armature is first deflected by the permanent magnet, breaking the circuit to the electropneumatic valve, which, however, is held closed momentarily by the discharge of the capacitor. The delay imposed by this means is 1 sec, which is sufficient to allow a train travelling at approximately $1\frac{1}{4}$ m.p.h. to pass from the permanent to the electromagnet before the valve opens (assuming the latter magnet to be de-energised).

Meanwhile, the deflection of the armature has made its south contact and energised the south relay. Supposing the signal to be "clear," the track electromagnet now restores the receiver armature, but the south relay remains energised through contact X and so a circuit is made from the battery through contact Y to the bell relay. Operation of this relay releases the south relay, restoring the circuit to the brake valve, but although this action disconnects the bell relay winding from the battery, the 1,500 μF capacitor now discharges through the winding and maintains the bell in operation for 2 sec.

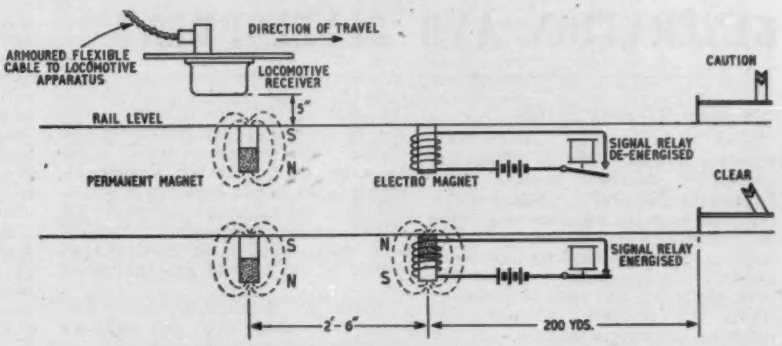
In the alternative conditions of a "caution" signal, the electromagnet in the track is not energised, so that the receiver armature is not restored, the bell relay is not energised, and after the 2,000 μF condenser has discharged the brake valve opens, causing air to enter the system and in so doing to sound the warning horn; a brake application begins after 3 sec if no action is taken by the driver. The time taken to destroy the vacuum is from 13 to 15 sec for train lengths up to 12 coaches, with a further 3 or 4 sec for trains up to 16 coaches. The driver can, however, restore the equipment and control the braking himself in the normal way by operating the re-set switch, which is mounted on his A.T.C. control unit in the cab. An indicator visible through a window in this unit changes from showing an all-black disc to alternate black and yellow sectors as a reminder that re-set action has been taken and the driver must continue to control the speed of the train until he sights the next signal.

Referring again to the circuit diagram, it will be seen that when the re-set switch is operated, the circuit through the south contact on the receiver armature and the south relay coil is broken, so that the relay is released, and a



Circuit diagram of locomotive apparatus in the British Railways A.T.C. system

new circuit is made through the receiver armature south contact, contact Z of the south relay and the "yellow" coil (Y) of the indicator. Movement of the indicator closes a contact which allows current to pass through the primary of the impulse transformer. This induces a high-voltage impulse in the secondary which passes through the re-set coil on the receiver bottom pole piece, magnetising this in such a direction that the armature is restored to its normal position. Current is thus cut off from the "yellow" coil of the indicator and diverted to the solenoid of the brake valve, silencing the horn and preventing or restoring any brake action. The indicator continues to show black-and-yellow until, on reaching the next set of track inductors, operation of the south relay makes a circuit through contact Z to the "black" coil (B).



Arrangement of magnetic inductors at the approach to a semaphore distant signal

The 3,500 μF capacitor in the primary circuit of the impulse transformer charges up when the re-set switch is operated and reduces the primary current to a few milliamps. Consequently, when this small current is broken by release of the switch, the current induced in the secondary is far too small to affect the receiver armature again. Arcing at the re-set switch contacts is also reduced by the presence of the condenser. The receiver re-set coil is wound so that it needs a minimum of 17 V to operate the armature, and so any possibility is removed of false re-setting through accidental contact between the re-set circuit wiring and the 12 V supply.

An improved pulse circuit is in course of development in which a small power transistor oscillator is used, operating in the frequency range 600 to 800 c/s and producing a 40 V pulse, whereas with the present arrangement a very high peak voltage (over 80 V) is necessary in order to obtain an average of over 17 V.

Work is also proceeding on the development of suppressor inductors for the track equipment, to divert the field of the permanent magnet and prevent it affecting the equipment of a locomotive passing over it in the opposite direction of running to that controlled by the signal, as occurs on single lines or when single line working is necessary in special circumstances on double-track lines.

Inductors of this kind were originally to have been installed to prevent a "caution" warning when approaching a semaphore signal with "stop" and "distant" arms on the same post, the former being at "danger." This principle has not been followed in the present equipment, however, and "caution" is sounded in the circumstances described. Other subjects of continuing experiment are the installation of the apparatus in diesel and electric locomotives and in multiple-unit electric trains with air brakes, both on lines with an overhead contact wire and with a conductor rail.

Equipment for the stages of the A.T.C. programme now being carried out has been ordered from a large number of firms. The equipment is valued at over £500,000 and comprises 2,000 sets of track apparatus and sufficient equipment and spares for fitting 2,000 steam locomotives.

VENTILATED MOTORS

A NEW British Standard has just been issued, B.S. 2960: 1958, which will ensure complete mechanical interchangeability of motors of different makes. It extends the application of standard dimensions established in B.S. 2083 for totally enclosed fan-cooled motors, to electric motors with protected, screen-protected and drip-proof enclosures, thus covering a very large proportion of all industrial motors.

In addition to the advantages of interchangeability, B.S. 2960 breaks new ground in the introduction of standard dimensioned motors using the recently developed Class "E" insulating materials which permit a temperature rise of up to 65 deg C in maximum ambient temperature of 40 deg C. This means that, for a given horse-power output, motors to the new Standard will be appreciably smaller and lighter than the previously non-standardised motors of this type which used Class "A" insulation. This reduction in size will, of course, bring about an appreciable saving in production costs due to economies in materials. Many manufacturers of the new motors are also introducing new production techniques which will still further improve productivity.

The Standard applies to three-phase, 50 c/s squirrel-cage, ventilated motors with continuous maximum ratings in the range 1 to 40 h.p. (at 1,500 r.p.m. synchronous speed) at voltages up to 650 V. The motors are of the foot-mounted, flange-mounted and skirt-mounted types.

It has been recognised that in certain special applications it may not be possible to operate motors up to the maximum temperature permitted with Class "E" insulation—hence the inclusion of an appendix which gives information on operating temperatures and includes a series of standard motor frames with corresponding reduced horse-power outputs for use in such circumstances.

It is intended to issue in due course an addendum to the Standard which will give maximum overall dimensions, on lines similar to those of the appendix to B.S. 2083. This will enable a user to determine the minimum space necessary to ensure the satisfactory accommodation of any make of motor.

Copies of this Standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 6s.

GENERATION AND DEVELOPMENT

Standard Off-peak Tariffs

With the increasing use of floor warming and other forms of storage heating in domestic premises, the Southern Electricity Board has reviewed both the structure and level of charges of its existing off-peak tariffs and has decided to introduce, as from 30th June next, standard off-peak tariffs for all types of premises which will represent a substantial reduction on present charges. At the same time, the alternative periods of availability will be increased so that the use of the supply at all times between April and September inclusive, as well as during the winter nights and week-ends, will be allowed as a minimum.

The actual rates of charge will vary with the periods of availability from 0·95d to 1·05d per kWh in the case of domestic consumers, and from 0·64d to 0·84d per kWh with the addition of an adjustment related to the price of fuel in the case of non-domestic consumers. There will be a rental in all cases for the time switch and meter necessary to control and measure the supply.

Full details of the tariffs will be published shortly, and tariff leaflets will be available at all the Board's service centres.

Ten Years' Progress in North-West

A Press conference was held at Manchester on 1st April at which Mr. T. E. Daniel, chairman of the North Western Electricity Board, reviewed the Board's achievements in the ten years since nationalisation. Consumers, he said, had increased in number by over 25 per cent to 1,590,000 and sales had risen from 4,445 million kWh to more than 8,000 million. In April, 1948, there were 18,000 miles of cable feeding consumers in the Area whereas there were now 24,000 miles. The Board had also provided eleven new grid supply substations.

The Board had earned revenue surplus in every year but one. Progressively over the years there had been a trend towards a higher degree of self-financing. In the ten years over £47 million was spent on capital works, of which £21 million went on reinforcing the distribution system and £19 million was spent on providing new or additional supplies. The sale of fittings account had shown throughout the years a satisfactory margin and is continuing to do so. The aggregate surplus in the ten years had amounted to nearly £1½ million.

On organisation, the chairman said that the Board had to find the most efficient and economical size of administrative unit without impairing service to the public. In its latest proposals it had moved towards the size of Sub-Area and District which should achieve these aims. The reduction in the number of administrative units would result in a corresponding lessening in expenditure on offices to be maintained. Further economies would be achieved as staff retired or left to take up other positions.

When the Board came into being there were more than 600 different methods of charging for electricity and as many unpublished ones. These had been replaced by about 15 principal tariffs in four main categories: domestic, industrial, farming, commercial. Electricity prices in the Area had risen to a less degree than almost any other commodity and were amongst the lowest in the country.

The Board had also supplied 200 per cent more electricity for use in coal-mining; added 24 service centres to the 89 taken over; sold (since 1953) 13½ million half-crown stamps to be used to pay accounts; sponsored successful agricultural and horticultural developments such as barn hay drying and soil warming; covered the whole Area with a short-wave radio system; certified for accuracy over 1½ million meters; encouraged manufacturers to bring down the cost of immersion heaters to less than pre-war; and supplied and installed in consumers' premises over £22 million worth of electrical equipment, including 227,000 cookers, 159,000 immersion heaters, 59,000 storage water heaters and 113,000 washing machines. The Board had also fostered the use of modern electrical forms of space heating, notably floor warming and block storage heating.

South Wales Achievements

At a luncheon held in the Angel Hotel, Cardiff, to mark the tenth anniversary of the establishment of the South Wales Electricity Board, the toast of the Board was proposed by Mr. A. J. Nicholas, O.B.E., A.M.C.T., M.I.E.E., immediate past-president of the Industrial Association of Wales and Monmouthshire. Responding, the chairman of the Board (Mr. W. A. Gallon, B.Sc., M.I.E.E., M.Inst.F.) said that the total capital assets taken over by the Board were valued at some £16 million, there were 4,700 employees, and sales of electricity in the year preceding vesting day by the 42 statutory, 16 non-statutory and eight National Coal Board electricity supply undertakings aggregated 2,250 million kWh. There were nearly 418,000 consumers. After ten years of Board operation the capital assets were valued at £49 million, there were 7,600 employees, and the total sales were 4,600 million kWh to 612,000 consumers. The average price per kWh sold had increased by only some 30 per cent. Indeed, as a measure of the economy which it has been possible to maintain, the internal costs of the Board's operations have been maintained at just over a ¼d/kWh for the whole of its existence.

In 1948 South Wales had a lower degree of rural electrification, judged by the standard of number of farms connected, than any other part of the country. Fewer than 3,000 farms out of approximately 25,000 were receiving a public supply, and there were virtually no main transmission lines in the rural areas. At 31st March this year the total number of farms connected had risen to more than 11,500, nearly four times as many as when they took over.

Sales in South West Nearly Trebled

Since 1948 the South Western Electricity Board had nearly trebled electricity sales and had brought supplies to about 250,000 more consumers, said Mr. A. N. Irens, the chairman, last week. He was speaking on the occasion of the 10th anniversary of the nationalisation of the industry. The welding of the former 39 different undertakings had been accomplished so successfully, he said, that in 10 years the number of employees had increased by only about a third to deal with nearly treble the use of energy. Further improvements in organisation just introduced should lead to still greater efficiency.

Mr. Irens said the Board now supplied over 735,000 consumers and every working day last year connected up an average of 85 more. Since 1948 about £30 million had been invested in improving and extending the electricity service in the South West.

The Board's last four annual reports had shown a balance in hand. Over the ten years, revenue had totalled about £150 million, but the resultant surplus had been rather less than 1 per cent—a slender margin.

Remarkable progress also had been achieved in extending the benefits of electricity to the countryside. Two-thirds of the area was without electricity ten years ago and in North Devon especially there were no mains at all from which to extend rural spur lines. The Board had carried out a comprehensive rural survey of 949 parishes, and a new 33 kV primary network had been built. Now, ten years later, 12,000 more farms and 77,000 other rural premises enjoyed electricity.

The average price per kWh sold was only 26 per cent more than that paid ten years ago and all the indications were that the cost of electricity, relative to other commodities, was likely to go on getting cheaper—especially when energy from the nuclear power stations began to flow

through the grid. The Board's vigorous commercial policy was designed to further the expansion of output, particularly at off-peak times. The retail trade in the Board's 120 service centres, mainly in heavy current consuming appliances such as cookers and water heaters, had quadrupled and was still going ahead.

Tariffs in South Scotland: Chairman's Statement

Although the South of Scotland Electricity Board has no definite proposals to make at present on tariff levels, the matter is being watched, said Mr. J. S. Pickles, chairman of the Board, on 27th March. He was addressing a meeting in Glasgow of the Electricity Consultative Council for the South Scotland District, to which he submitted the Board's annual report.

After giving a reminder that tariffs in the area had remained unchanged since October, 1955, Mr. Pickles added: "But we may have to consult you later this year on this matter."

The question of a rise in price, he said later, depended on the cost of coal and possible wage adjustments in the interval. "We are the only Board in the United Kingdom to hold our tariffs steady during the past three years, and we are doing our best to maintain that record. At the moment we are not contemplating a rise in cost to the consumer, but the situation is being watched."

The industry, Mr. Pickles pointed out, had managed to absorb increases in coal costs and wages during the past three years without passing them on to the householder, but there was a limit to what it could do in that direction.

PARLIAMENTARY REPORT

IN recent weeks, many questions have been put to the Government on the possible lifting of embargoes on exports to Russia and China. The Government spokesmen have replied that the revision of the banned list is now being undertaken by C.O.C.O.M. (the Co-ordinating Committee of the Western Powers) in Paris. The decisions are expected to be announced in June.

In the House of Lords Lord Elibank asked whether the Government's attention had been drawn to the inclusion of ingot copper among the goods to be supplied to China by Japanese exporters under an agreement concluded on 5th March.

Lord Mancroft, Minister without Portfolio, replied that this was a non-governmental agreement in which ingot copper was one of a number of items which might be exported to China from Japan. However, as long as copper remained embargoed, it could be assumed that the Japanese Government would not permit its export to China unless they had first ascertained and considered the views of the Paris consultative committee.

Increased Duty on Antimony

When Mr. J. K. Vaughan-Morgan, Minister of State, Board of Trade, moved the approval of the Additional Import Duties (No. 2) Order, 1958, in the House of Commons, he explained that it would increase to a rate of 25 per cent *ad valorem* or £40 a ton, whichever was the greater, the import duty on antimony in any form, and on alloys which contained not less than 85 per cent by weight of antimony, and on antimony oxides and mixtures containing not less than that proportion of antimony. Explaining that antimony metal was used for hardening lead, particularly that used in lead storage batteries, cable sheaths, bearings, etc., the Minister said the application for an increase in import duty was submitted on the ground that the existing duty was insufficient to protect the United Kingdom industry against low-priced imports coming primarily from China, and to a lesser extent from Russia. The Order was approved.

Use of Small Coal

Major Sir William Anstruther-Gray asked the Paymaster General what steps he was taking to encourage consumers of scarce grades of coal to convert their plant to the use of other grades which were more plentiful.

Sir Ian Horobin said the use of the smaller sizes of coal was being encouraged directly or indirectly by the Clean Air Act, railway electrification, the Government loan scheme and income tax investment allowances, the National Coal Board's pricing policy, and the offering of technical advice. These steps had played a notable part in reducing the inland use of large coal from 53 million tons in 1956 to 49 million tons last year.

Control of Signs

Mr. John Hall asked the Minister of Housing and Local Government what reply he had given to the proposals of the Electrical Sign Manufacturers' Association for relaxing the present control on illuminated signs without detriment to amenity or public safety which were submitted to him on 9th July last.

Mr. Bevins, Parliamentary Secretary, said the Association were told that their proposals would be taken into consideration in the drafting of the new regulations. This was done. The Minister's provisional view was that he could not accept their main proposal for relaxing control over illuminated signs on business premises, but that local planning authorities ought to be given wider discretion than they had at present to allow illuminated signs in areas of special control. Draft Regulations based on this view had been circulated to the Association and other bodies, and their comments were now being considered.

Transport of Uranium

Mr. Frank Allaun asked the Prime Minister if he was satisfied that no serious accident could result from carrying uranium by road through built-up areas between atomic power stations and Windscale and what further precautions he proposed to lay down.

Mr. Macmillan said the methods which would be used to transport radioactive materials between the atomic power stations now under construction and Windscale were being discussed by the Atomic Energy Authority and the Central Electricity Generating Board. He was satisfied that they would observe the same high standard of safety precautions as the Atomic Energy Authority did now in the transport of their own radioactive materials.

Nuclear Power Programme

In answer to a question by Mr. Moss, Sir Ian Horobin said that the nuclear power programme now provided for the installation of 5,000-6,000 MW of capacity by the end of 1966. The re-phasing of the programme would increase power station consumption of coal by some 3 million tons a year. No further change in the programme was contemplated at present.

Questioned further, he said it was true that they anticipated savings in the capital cost of nuclear stations, but there was nothing yet sufficiently certain to warrant a major change in the programme in the immediate future.

Purchase Tax on C.R. Tubes

Mr. Arthur Lewis asked the Chancellor of the Exchequer whether he was aware that purchase tax on television cathode-ray tubes had to be paid not only when these were included in new television sets, but even on replacements; and, as most items of replacement of parts were tax free, whether he would arrange for television cathode-ray tubes for replacement to be free.

Mr. Heathcoat Amory said that if the tubes were supplied as free replacements under the manufacturers' guarantee, tax was not, in practice, charged. As for the rest of the question, he could not anticipate his Budget statement.

NEW ELECTRICAL EQUIPMENT

Scanning Recorder

An instrument, designed to scan a large number of points (say 100-200 thermocouples) and record these sequentially, has been introduced by the CAMBRIDGE INSTRUMENT CO., LTD., 13, Grosvenor Place, London, S.W.1. It is a direct modification of the Cambridge single-point model "DE" electronic recorder (which employs a glass siphon pen drawing a continuous curve) and can be arranged to revert to this function, i.e. monitoring on any selected point, on demand or automatically.

When recording a measured value from the scanning system, the recorder pen starts from zero on the chart, makes an excursion upscale to the measured value, and then returns to the zero position along the same line. The chart is then stepped forward approximately 0·1in and the next point is measured in the same manner.

Junction Transistors

A number of new junction transistors are announced by RCA GREAT BRITAIN, LTD., Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex. These transistors are specifically designed for use in medium-speed, high-current switching circuits of compact military and industrial electronic computers. Full details can be obtained from the company.

P.V.C. Welding Machine

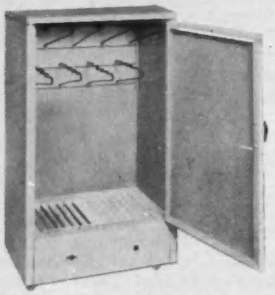
A welding machine for p.v.c. is being produced by H.F. INDUSTRIAL SERVICES, LTD., 317-319, High Road, Wood Green, London, N.22. The No. 1 Acme machine, rated at 1·5 kW, has been designed to overcome the problem of flash and burn. It is easily moved around, rubber castors being provided at the heavy end. Operation is by foot pedal, the stroke of which is adjustable to suit individual operators.

A feature of this machine is the precision built press which has been specially designed to exert pressures up to 400 lb. The work lamp lights only when the machine is warmed up and ready for operation. It also goes out on completion of the weld cycle, coming on again on release of the pedal by the operator. Sets of interchange parts such as the top mounts for the press and plattens for the bottom make it possible for an unusually wide range of sizes and types of work to be carried out on the standard machine. Whether it be simple bag sealing, garment or curtain making, etc., change-over can be effected in a few minutes. Depth of penetration is micrometer controlled up to one-thousandth of an inch.

H.F. Industrial Services p.v.c. welding machine

Clothes Drying Cabinet

A clothes drying and airing cabinet which, with the addition of a special wire tray, can also serve as a crockery dryer, is now being manufactured by LAMB, HINGLEY & CO., LTD., Lye, Stourbridge, Worcs. It is made from rust resisting sheet steel and the standard finish is cream enamel; castors are fitted. The loading of 1 kW can be reduced to half-heat, for airing purposes, by means of a kick-switch.



Lamb, Hingley "Electrapex" clothes drying cabinet

A neon light indicates when the current is on. Nine clothes hangers are provided and there is completely free access to the clothes as, apart from a door being fitted, the table top lid can be raised. The drying cabinet, known as the "Electrapex" model No. 702, is 36in high by 21in wide by 15in deep. The price is £11 13s 6d plus £5 2s 6d purchase tax in the United Kingdom.

Soldering Iron

A soldering iron with a fully insulated element mounted inside a steel shaft approximately 3·5 mm in diameter is announced by A.N.T.E.X., LTD., 3, Tower Hill, London, E.C.3.

A.N.T.E.X. miniature soldering iron

Exact soldering temperature is maintained at the bit, and with the insulated element this iron is suitable for soldering transistorised circuits. All danger of overheating and damage to transistors has been eliminated and live circuits can be soldered without harm. The element is sealed and protected by a shock absorber and the element assembly can be replaced by the operator in 30 seconds. Spare bits are heavily nickel plated and bits can be renewed instantly by the operator as slots have been provided to prevent bits corroding to the shaft.

List price in the U.K. is £1 9s 6d for the mains voltage models and £1 5s for the low voltage range (6 V-50 V). The iron weighs 1 oz and is 6½in long.

Spin Dryer

A recent announcement from the Frigidaire Division of GENERAL MOTORS, LTD., Stag Lane, Kingsbury, London, N.W.9, states that as part of a general expansion programme the company has decided to widen its field of operations in the electrical appliance market.

The first of the new appliances to become available is the "Cascade" spin dryer, an entirely automatic machine with a drum capacity of 6 lb, dry weight. It is powered by a 9,000 r.p.m., ½ h.p. a.c. motor and the drum speed is in the region of 2,800 r.p.m. The machine is set in operation by closing the lid and can be stopped either by a special thermal cut-out device, which operates after the spinning cycle is completed, or by raising the lid which automatically applies a safety brake to the drum.

Water from the clothes is extracted

Frigidaire "Cascade" spin dryer

through slots in the centre of the 9¾in diameter drum wall and diverted through a spout into the collection bucket. The water extraction rate is claimed to be 85 per cent in the first half minute, 95 per cent after 1 minute and the final 5 per cent during the remainder of the spinning cycle, which is completed in 4 minutes or less.

The external finish of the machine is white stoved enamel with grey trims and the drum finish is porcelain on steel. The dryer is 25in high by 15in diameter and the total weight is 53 lb. Three rubber feet are fitted and a single transportation wheel. By grasping the bar-type handle fitted to the front of the machine and tilting it backwards it can be easily wheeled into any desired position. The price is £24 16s 3d plus £10 17s 9d purchase tax in the United Kingdom.

Lamp Safety Device

A safety device for high wattage lamps is now available to special order from CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London, W.C.2. This device is designed to prevent the possibility of a lamp shattering at the end of its life, which may result from the thermal shock of molten metal falling from the filament or supporting wires.

The safety feature consists of a circular platform of transparent material inserted into the bulb during manufacture. With the lamp used in its normal position, that is cap upwards, the platform, being free to move, assumes a horizontal position at the base of the bulb and prevents any molten metal from reaching the glassware. If the lamps are required for angular operation, the platform is easily persuaded to assume a position beneath the filament system and thus afford the same protection.

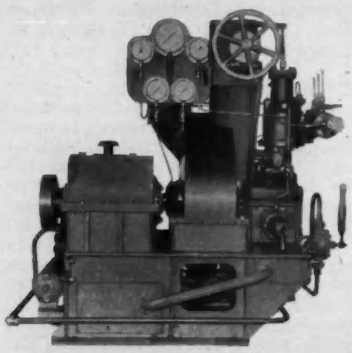
High-frequency Alternator

The current difficulty in obtaining a supply of 400 c/s power of sufficiently close voltage regulation and accuracy of wave shape under load conditions has prompted the introduction of a new range of alternators by the MACFARLANE ENGINEERING CO., LTD., Cathcart, Glasgow. The new alternators are a development of this company's "Magnicon" design and will supply 400 c/s current with inherent voltage regulation under any combination of load, resistance, inductive and reactive, while maintaining good wave shape.

Small Steam Turbines

A new range of small, high speed, geared steam turbines, rated at from 200 to 1,000 h.p., is announced by J. P. HALL & SONS, LTD., Peterborough. The basic turbine remains unchanged throughout the range, with only detail differences to suit particular working conditions. For example, new nozzles and throttle valve seats can be supplied to adapt existing turbines for modified working conditions. The fitting of these items is very simply carried out, and a turbine can be quickly converted for altered steam and exhaust conditions.

The basic turbine is a velocity compounded impulse machine, mounted on a rigid fabricated combined frame and gearbox. A hydraulic constant speed governing system, with manual speed variation control, hand trip control at the turbine, forced lubrication with oil circulation indicators, full flow oil filter, oil cooler, overspeed trip device, relief valve, tachometer, pressure gauges, etc., form part of the standard equipment. The turbine can be used for many land and marine purposes, for driving pumps, compressors, fans, etc. It is suitable for exhausting either to vacuum, or against back pressures, and is especially suitable for oil refinery installation or for driving mill machinery, where low pressure steam is required.



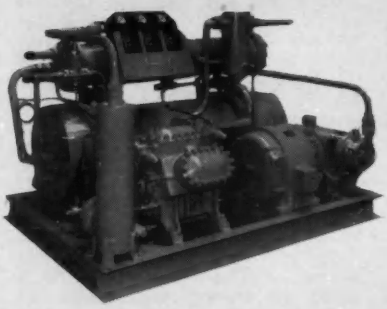
J. P. Hall geared steam turbine

Water Chilling Unit

The LIGHTFOOT REFRIGERATION CO., LTD., of Wembley, Middlesex, has developed a new range of packaged water chilling equipment. These units are available in graduated capacities from 10 to 100 h.p. The smallest is 6ft by 4ft by 3ft 9in high. The unit is complete and ready for connecting to water and electricity supply.

The refrigerating equipment, comprising an Arcton 6 (F.12) compressor with motor, water cooled condenser, direct expansion cooler and chilled water circulating pump, together with controls, is mounted integrally on a rigid base which is constructed from heavy section, welded steel channel and eliminates the necessity for special concrete foundations. The compressor is arranged for no-load starting and the operation of the unit is entirely automatic.

Lightfoot 10 h.p. packaged water chiller



Mobile Battery Charger

A standard Villiers Mark 20, air-cooled, four-stroke industrial engine, which is close-coupled by taper shaft and spigoted crank case to a single bearing 1·5 kW shunt-wound generator, forms a mobile battery charger made by DALE ELECTRIC (YORKSHIRE), LTD., Electricity Buildings, Filey, Yorks. The complete unit runs at a speed of 2,600 r.p.m. The control panel is fitted with an output voltmeter and ammeter, hand field voltage regulator, automatic battery cut-out, main switch, connection terminals and a panel illumination lamp. The output rating is 24-32 V, 62/47 A d.c.

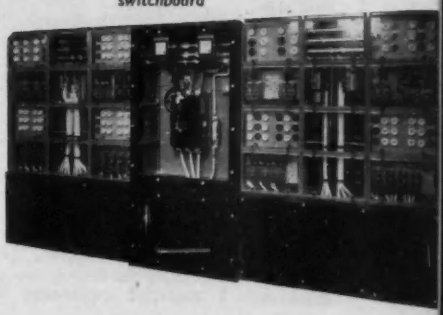
Dale Electric mobile battery charger

Unit Switchboard

Moulded unit type switchboards with transparent covers and busbar ratings of 100 A, 200 A, 400 A and 600 A are now being produced by KLOCKNER MOELLER (ENGLAND), LTD., 7, Charter House Buildings, Goswell Road, London, E.C.1. The panels may be floor or wall mounted and are dust-tight and splash-proof.

Transparent fronts make easy inspection possible so that faults can be located immediately. Built-in bayonet type fastenings allow covers to be removed in a few seconds.

Klockner Moeller moulded unit type switchboard



Financial Section

STOCKS and SHARES

IN spite of some bad patches during the first part of this year, Stock Exchange markets reached Easter with prices showing, on balance, not a great deal of variation from those ruling at the start of the year. In the gilt-edged market, which felt most directly the benefit of last month's Bank Rate reduction, quotations were indeed showing appreciable gains. For industrials the average was showing an almost negligible decline, and in some sections, including electrical equipment, many shares had done better than hold their ground. Adverse factors during the period centred round the state of American business, and at home the shrinkage of profit margins in industry and the problem of wage claims. On the other hand, confidence has been aided by the improvements in sterling and the gold reserves to the point at which it was considered safe to reduce the Bank Rate to a less abnormal figure.

Firm Prices

As is shown by the following table of comparisons, many electrical shares at least maintained, and in a number of cases improved, their value between the beginning of the year and Easter:—

Ordinary Share	Price		Change
	Jan.	April	
A.E.I.	47/6	49/–	+1/6
Automatic Telephone	57/6	64/3	+6/9
Bacock & Wilcox	53/9	47/6	–6/3
B.I.C.C.	40/3	40/9	+6d
Chloride Electrical	57/6	59/3	+1/9
Cole, E. K.	17/–	17/6	+6d
Crompton Parkinson	10/–	9/1½	–10½d
Decca "A"	24/6	25/6	+1/–
E.M.I.	27/9	31/9	+4/–
Elliott-Automation	12/–	12/6	+6d
Enfield Cables	12/9	13/3	+6d
English Electric	47/6	52/6	+5/–
Ericsson	19/3	19/3	—
G.E.C.	37/6	30/3	–7/6
Henley's	11/–	13/9	+2/9
Hoover	32/6	35/6	+3/–
International Combustion	21/–	24/3	+3/3
Johnson & Phillips	18/9	15/6	–3/3
Lancs. Dynamo	32/6	33/3	+9d
Lucas	28/–	33/6	+5/6
Parsons	52/6	48/9	–3/9
Plessey	60/–	58/6	–1/6
Pye "A"	12/6	11/6	–1/–
Reyrolle	80/–	79/3	–9d
Smith, S.	7/3	8/3	+1/–
T.C. & M.	23/6	23/9	+3d
Thorn Electrical	21/3	21/–	–3d
Westinghouse	32/6	36/6	+4/–
West, Allen	9/9	9/6	–3d

Good Results

On the whole, the industrial markets have received good support from the company dividend declarations and financial statements issued to date in respect of 1957. Of companies in the electrical and associated industries, English Electric were as usual one of the first to issue their report, and made a particularly good impression in disclosing a material expansion of earnings and the maintenance of the dividend on larger capital. Results of A.E.I. were also well up to expectations. Decca, Hoover, Mather & Platt, Watford Electric and Aberdare Cables were among the companies to pay dividends at the same rate as before from higher earnings. Enfield Cables returned to the dividend list, and good results permitted some increase in the distributions from, among others, International Combustion, Desoutter Bros., Taylor Tunnicliff, S. Bird, A. F. Bulgin and Ericssons.

Reyrolle Results

There was little initial change in the price of A. Reyrolle £1 shares, at about 79s 3d, after the declaration of the final dividend, which makes the same total as last year's 17½ per cent. The increase in the net profit for 1957 from £1·26 to £1·35 million (after an increased tax charge of £1·4 million) was much in line with expectations. It goes part of the way towards recovering the setback of the previous year in which, although output reached record levels, profits were reduced by rising costs and smaller margins. From the preliminary profits statement for 1957, the dividend appears to be covered a little short of three times over by the distributable surplus of earnings. In the market the cover is generally regarded as being wider than it appears to be, because of the importance of the company's 40 per cent holding of the C. A. Parsons ordinary capital. This is one factor in the quotation of the shares on the relatively low yield basis of 4½ per cent.

Elliott-Automation

Among the annual reports to come from companies which ended their financial years with the calendar, the results of Elliott-Automation are awaited with special interest. They will be the first to be published since the company was reorganised last August to give effect to the merger between the businesses of Associated Automation (formerly Hall Telephone Accessories) and Elliott Bros. (London). Since then the 5s ordinary shares have been a consistently firm and active market: at 12s 6d they have an uncommon distinction in standing near the best prices recorded this year or last. At the time of the merger, group profits of the two companies for 1957 were officially estimated at a combined total of not less than the £803,000 earned in the previous year. If this estimate were realised, the intention was to pay for the last five months of the financial year a dividend of 4⅛ per cent, equivalent to an annual rate of 10 per cent.

Ericsson Telephones

Turnover of the Ericsson Telephones company increased by 12 per cent in 1957, but operating costs were raised by the increase in engineering wages and there was a substantially heavier depreciation charge. As a result the trading profit came out £163,000 lower at just over £1¼ million, which, however, comfortably accommodated the improvement of the ordinary dividend to a total equivalent to 12 per cent net on the present capital of £2 million. This decision, followed by Sir Harold Wernher's review at the annual meeting, confirmed the high investment status of the shares on which, at a price of 19s 3d, the gross yield is close on 5½ per cent. In the past two years the company has financed entirely from its own resources expenditure of £1½ million on new buildings and plant, and an increase of a million in the stocks and work figures. The chairman said that the present year started with a good order book.

April Dividends

If last year's timing of the declarations is repeated, the electrical market will hear a number of interesting dividend announcements and preliminary 1957 profits statements in the second half of this month, including those of Chloride Electrical Storage, Allen West and Bowthorpe Holdings. Shares of the first named have been well supported lately on the strength of the motor industry's high output figures. Dividends of 17½ per cent have been paid on each of the last three occasions, and that rate gives a yield of a fraction over 5½ per cent on the £1 "A" shares at 59s 6d. Final dividends from Allen West and Bowthorpe will both be payable on capital increased by scrip issues since last year. Adjusted for these, Allen West's last dividend (a single annual payment) was equivalent to a rate of approximately 11½ per cent on the present capital, giving a yield on the 5s shares, at 9s 6d, of 6·1 per cent; and the Bowthorpe rate was equal to 18¾ per cent, making the yield 4·8 per cent on the 2s shares at 7s 9d. Automatic Telephone and Electric are expected to decide their final dividend recommendation next Tuesday, 15th April.

[*Our share list, which is not published owing to the Easter holiday, will appear as usual next week.*]

Peña-Peto Scott Agreement

Following the acquisition by the Peña Group of an 84 per cent holding in Peto Scott Electrical Instruments, Ltd., as a result of an offer made to the minority shareholders of that company, the directors of Peña and Peto Scott have agreed that the electronic activities of the Peña Group should be centralised upon Peto Scott. Peña's electronic activities are currently under the general supervision of one of its directors, Mr. A. T. Black, formerly director of Electronics Production, Ministry of Supply. In consequence, Mr. Black has been appointed managing director of Peto Scott, thus enabling Mr. J. C. Drewe to deal with all Ministry and industrial electronic sales and contracts for the whole of the Peña Group.

REPORTS and DIVIDENDS

Enfield Rolling Mills, Ltd.—The group trading profit for 1957 amounted to £1,685,424, as compared with £1,495,129 for the preceding year, and after meeting all charges, including £757,000 for taxation, the net profit is £630,650 (against £531,474). After deducting share issue expenses of £44,027, and £279,459 written off goodwill of subsidiaries, it is proposed to pay a final ordinary dividend of 10 per cent, making 12½ per cent for the year on capital increased to £4,160,000 by a one-for-one issue of fully paid shares and a one-for-three "rights" issue. For 1956 an interim dividend of 5% per cent was paid on capital of £1,555,000, followed by a final dividend of 10 per cent on the capital after the issue of fully paid shares but before the rights issue. The balance carried forward is £130,945 (against £133,131 brought in).

A. Reyrolle & Co., Ltd.—The preliminary statement for 1957 shows profits of £2,762,274, as compared with £2,563,273 for 1956. Taxation requires £1,409,188 (against £1,303,353) and the net profit is £1,353,086 (£1,259,920). It is proposed to pay a final dividend of 11 per cent, making 17½ per cent for the year. A similar distribution was made for 1956, but the interim dividend of 6½ per cent for that year was paid on smaller capital.

G. & J. Weir, Ltd.—After deducting £1,114,320 for taxation, the group net profit for 1957 is £981,204 (as compared with £1,401,414 for 1956), of which £707,804 is attributable to the parent company. Reserves receive £369,349 and it is proposed to pay a final dividend of 12½ per cent, making 16 per cent for the year on capital doubled by a scrip issue. For the previous year the total distribution on the smaller capital was 30 per cent. The balance carried forward is £305,955 (against £338,869 brought in).

Ozonair Engineering, Ltd.—The trading profit for 1957 amounts to £92,329, as compared with £58,098 for the previous year, and the gross profit, before taxation of £35,359, is £67,847 (£39,200). The ordinary dividend for the year is 15 per cent (same) on increased capital plus a bonus of 10 per cent (nil). Reserves receive £14,500 and £16,514 is carried forward (against £5,713 brought in).

Associated British Engineering Ltd., announces that it has now arranged to complete the acquisition of the whole of the share capital of Mackay Industrial Equipment, Ltd., Feltham, Middx, and of a 60 per cent interest in the equity of its associated company in Kenya, the Blake, Mackay Engineering Co. (Africa), Ltd., together with certain preference shares and loans of the latter company. Arrangements in connection with the acquisition were made some time ago and Associated British Engineering, Ltd., has already paid on account of the purchase price sums totalling £101,000. The balance of the purchase price, namely £181,500, is being met as to £50,000 by the issue of 50,000 6 per cent cumulative preference stock and £42,110 by the issue of £42,110 ordinary stock of Associated British Engineering, and as to £89,390 in cash of which £9,390 is being paid and the balance of £80,000 is payable by agreed instalments over a period of one year. Associated British Engineering, Ltd., has additionally acquired further interests totalling 25 per cent in the equity of Blake, Mackay Engineering Co. (Africa), Ltd., over the past two years from other sources, so that its total interest in the equity of that company is 85 per cent.

Murphy Radio, Ltd.—Group net profits rose from £235,555 in 1956 to £266,829 in 1957. This figure is struck after deducting £336,370 for taxation, and after crediting taxation adjustments of £3,882. General reserve receives £100,000, and the dividend for the year is maintained at 20 per cent. The balance carried forward is £298,628 (against £257,005 brought in).

Eveready South Africa, Ltd., has declared an interim dividend of 10 per cent (unchanged).

J. & F. Stone (Lighting & Radio), Ltd., have declared an interim dividend of 10 per cent (unchanged).

Increases of Capital

E.M.B. Co., Ltd.—Increased by £50,000 in £1 unclassified shares, beyond the registered capital of £200,000.

Giles (Electrical Engineers), Ltd.—Increased by £10,000 in £1 ordinary shares, beyond the registered capital of £8,500.

Electrical Equipment Co. (Leicester), Ltd.—Increased by £17,000, in £1 shares, beyond the registered capital of £15,000.

Grelco, Ltd.—Increased by £49,000, in £1 "B" shares, beyond the registered capital of £1,000.

Pritchett & Gold Batteries (Eastern), Ltd.—Increased by £40,000, in £1 ordinary shares, beyond the registered capital of £10,000.

New Companies

Penco Research & Development Co., Ltd.—Registered 26th February. Capital £100. Mechanical, electrical and radio engineers and consultants, workers and dealers in and research into mechanical and electrical apparatus and goods, etc. Directors: A. T. Black, Alexander Rubach, R. C. Heath, J. W. Hervin, N. B. Rajchenbaum and A. Schumann. Regd. office: 2/4, Brook Street, W.1.

S. D. Pryor, Ltd.—Registered 26th February. Capital £5,000. Electrical, electro-mechanical, electronic, radio, television, telephone, lighting, heating, motor, aeronautical and general engineers, etc. Directors: Truswell & Son, Ltd., and S. D. Pryor. Regd. office: 87, Hassall Street, Newcastle-under-Lyme.

F. W. Killingback, Ltd.—Registered 27th February. Capital £300. Electricians, electrical, mechanical and general engineers, etc. Directors: F. W. Killingback, H. V. Attaway and E. A. Mackney. Regd. office: 40, Essex Street, N.1.

Neuclex Co., Ltd.—Registered 27th February. Capital £100. Manufacturers of and dealers in electrical, electronic and mechanical devices, etc. Directors: R. A. Brash and E. J. Bird. Regd. office: 44a, Oak End Way, Gerrards Cross, Bucks.

East Grinstead Electronic Components, Ltd.—Registered 13th March. Capital £5,000. Electronic, electrical, radio and television engineers, etc. Directors: A. Meoni and F. E. Omegna. Regd. office: 5, Great Winchester Street, Old Broad Street, E.C.2.

Emerson Electronics, Ltd.—Registered 13th March. Capital £1,000. Manufacturers, importers and exporters of and wholesale and retail dealers in and repairers of radio transmitting and receiving sets, television sets, etc. M. Raymond is the first director. Regd. office: Brent Crescent, North Circular Road, N.W.10.

C. & S. L. Radiovision, Ltd.—Registered 17th March. Capital £1,000. Manufacturers, repairers, servicers, hirers out of and dealers in radio, electrical and mechanical apparatus of all kinds, etc. Directors: H. A. De Solla and Elizabeth K. De Solla. Regd. office: 95, Croydon Road, Caterham, Surrey.

G. W. Marsh, Ltd.—Registered 17th March. Capital £3,000. Manufacturers of and dealers in radio goods, radio receivers and transmitters, television sets, etc. Directors: G. W. Marsh and Mrs. Frances L. Marsh. Regd. office: 151, Town Street, Stanningley, Pudsey, Yorks.

Park Lane Electrics, Ltd.—Registered 17th March. Capital £1,000. Manufacturers of and dealers in electrical apparatus and equipment, etc. Directors: J. W. Parker and P. A. Gardner. Regd. office: 548, Romford Road, E.12.

Refrigerator and Electric Appliance, Ltd.—Registered 18th March. Capital £100. Directors: S. Brooks and Ethel Brooks. Regd. office: 2, Grasmere Road, Blackpool.

Washmaster, Ltd.—Registered 25th March. Capital £100. Manufacturers of and dealers in washing machines, etc. Solicitors: Theodore Goddard & Co., 5, New Court, W.C.2.

J. H. Plant (Crawley), Ltd.—Registered 28th February. Capital £100. Electricians, mechanical engineers and manufacturers, workers and dealers in electricity, motive power and light, etc. Regd. office: 26/28, Hallam Street, W.1.

J. H. Plant (Retail), Ltd.—Registered 28th February. Capital £100. Regd. office: 10, Brighton Road, Crawley, Sussex.

Bankruptcies

S. L. Blythe, G. N. Bryan and **D. Mosley**, formerly trading together in co-partnership under the style of Kirkstall Radio & Electrical Service at Kirkstall Lodge, Edwinstowe, Notts, radio and electrical engineers. (Separate application of S. L. Blythe).—Order made 14th February suspending bankrupt's discharge for two months until 14th April.

G. Love and **F. E. Love**, trading as Love Bros., Holt Road, North Elmham, Norfolk, cycle, radio and electrical engineers and newsagents.—Receiving order made 27th March on debtors' own petition. First meeting to-day (Friday) at the Official Receiver's office, Castle Chambers, Opie Street, Norwich. Public examination, 20th May at the Shirehall, Norwich.

J. Vipond, electrical sub-contractor, formerly carrying on business at 6, Taunton Road, Sparkbrook, Birmingham, 12, as an electrical contractor.—Trustee, Mr. W. Le R. Hand, Colmore House, 21, Waterloo Street, Birmingham, 4, appointed 25th March.

V. F. Pitt, electrical engineer, 54, Mortimer Street, Herne Bay, Kent.—Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1, released 18th March.

E. Newland, electrical contractor, 130, Grove Road, Chadwell Heath, Romford, Essex.—Third and final dividend of 3s in the £, payable at 18, Bentinck Street, London, W.1.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 16th April from the Patent Office, 25, Southampton Buildings, London, W.C.2

1954

10492. Standard Telephones & Cables, Ltd.—Photo-sensitive controlling circuits. 1st April, 1955. (793523.)

11684. Soc. Nouvelle de l'Outillage R. B. V. et de la Radio-Industrie.—Photo-electric cells. 22nd April, 1954. (793357.)

16889. Hutchings, E. L.—Electric lamp-holders. 9th June, 1955. (793526.)

28670. Enfield Cables, Ltd.—Tapes particularly for use in electric cables and making up articles such as manifolds. 3rd October, 1955. (Cognate application 5333, 22nd February, 1955.) (793247.)

29294. Sylvania-Thorn Colour Television Laboratories, Ltd.—Colour television receivers. 6th October, 1955. (793351.)

32917. Thorn Electrical Industries, Ltd., and Sylvania-Thorn Colour Television Laboratories, Ltd.—Colour television. 8th November, 1955. (Cognate application 10350, 7th April, 1955.) (793352.)

1955

1123. Watford Electric & Manufacturing Co., Ltd.—Electric supply change-over switching apparatus. 13th January, 1956. (793369.)

7363. National Research Development Corporation.—Transistor oscillators. 12th March, 1956. (793537.)

8013. General Electric Co.—Clothes-washing machines. 18th March, 1955. (793310.)

8016. British Thomson-Houston Co., Ltd.—Incandescent electric lamps. 13th March, 1956. (793256.)

8859. Henley's Telegraph Works Co., Ltd., W. T., Farrer, C. O., and Plews, C.—Adjustable glands. 23rd March, 1956. (793311.)

9433. General Electric Co., Ltd., and Runciman, R. D.—Magnetic focusing devices for use with cathode-ray tubes. 26th March, 1956. (793257.)

9957. British Thomson-Houston Co., Ltd.—Electrical contact brushes for high altitude electrical equipment. 28th March, 1956. (793455.)

11731. Muirhead & Co., Ltd.—Speed control of electric motors. 20th March, 1956. (793458.)

12549. Ever Ready Co. (Great Britain), Ltd., and Gibbins, A. E.—Dry cells. 14th March, 1956. (793542.)

13062. T. & T. Works, Ltd., and Wright, E. L.—Electric driving means for conveyors. 7th May, 1956. (793299.)

13188. Standard Telephones & Cables, Ltd.—Telephone signalling systems. 6th May, 1955. (793543.)

13341. Philips Electrical Industries, Ltd.—Electric signal transmission systems. 9th May, 1955. (793544.)

13406. British Thomson-Houston Co., Ltd.—Electric coils having polygonal turns, and method of making the same. 9th May, 1956. (793545.)

14109. General Electric Co.—Mixed ferromagnetic ferrites. 16th May, 1955. (793551.)

14374. Goodmans Industries, Ltd.—Microphones. 16th August, 1956. (793546.)

15489. Belling & Lee, Ltd.—Electric plug and socket connector. 24th May, 1956. (793547.)

15873. Giravions Dorand. — Electro-mechanical double time integrating unit, a computer for solving differential equations comprising such units, and apparatus comprising such units for simulating the movements of a body in flight. 2nd June, 1955. (793374.)

16018. Southern United Telephone Cables, Ltd.—Extrusion presses. 1st June, 1956. (793375.)

16926. Reslosound, Ltd.—Electromechanical transducers. 13th September, 1956. (793261.)

18160. Forbes, A. A.—Adaptor for electric plug and socket couplings. 24th September, 1956. (793553.)

19158. British Thomson-Houston Co., Ltd.—Control systems for electric winder drives. 26th June, 1956. (793557.)

23684. Hunt (Capacitors), Ltd., A. H.—Casing of electrical components, such as capacitors. 17th August, 1956. (793380.)

23945. Signal-Stat Corporation.—Snap action electric switches. 19th August, 1955. (793564.)

27274. Ward & Goldstone, Ltd., and Couyoumdjian, A. O.—Shuttered electric socket connectors. 24th September, 1956. (793266.)

29171. Halliday, M. C.—Electric water heating devices. 19th June, 1956. (793572.)

29712. British Insulated Callender's Cables, Ltd.—Means of securing electric cables to support surfaces. 18th October, 1956. (793322.)

30752. Thor Power Tool Co.—Switch actuating mechanism for an electric tool. 27th October, 1955. (793573.)

31583. Research Corporation.—Electrostatic precipitators. 4th November, 1955. (793388.)

31676. Siemens-Schuckertwerke Akt.-Ges.—Processes for the production of insulating layers. 4th November, 1955. (793267.)

35228. Woden Transformer Co., Ltd., and Mitchell, H. W.—Electrically heated mesh screens on mesh panels. 22nd March, 1956. (793579.)

36852. Siemens-Schuckertwerke Akt.-Ges.—Discharge lighting installations. 22nd December, 1955. (793582.)

1956

1421. General Dynamics Corporation.—Electrostatic printing. 16th January, 1956. (793331.)

2022. General Electric Co.—System for controlling parallel circuits supplying a common load. 20th January, 1956. (793278.)

3072. Philips Electrical Industries, Ltd.—Pulse generators for cathode-ray oscillographs. 31st January, 1956. (793588.)

5053. Sylvania Electric Products, Inc.—Television receiver. 17th February, 1956. (793281.)

6916. Hammond, J. H.—Method and apparatus for relaying television-type signals over long distances. 5th March, 1956. (793332.)

8597. Falk, Stadelmann & Co., Ltd., and Beer, A. J.—Means for mounting an electric switch within a cavity formed in a wall or other surface. 20th March, 1956. (793604.)

11016. Philips Electrical Industries, Ltd.—Apparatus for charging electric fences. 11th April, 1956. (793399.)

13829. Standard Telephones & Cables, Ltd.—Amplifying system comprising a negative-impedance repeater associated with a transmission line. 4th May, 1956. (793400.)

14310. General Electric Co., Ltd.—Cold pressure welding. 8th May, 1956. (793402.)

14927. Svenska Aktiebolaget Gas-Accumulator.—Responding radar beacons. 14th May, 1956. (793287.)

14961. Dole Valve Co.—Electric thermostatically controlled switches. 14th May, 1956. (793403.)

17618. Lonza-Werke Elektrochemische Fabriken Ges.—Extrusion presses. 7th June, 1956. (793497.)

19611. Philips Electrical Industries, Ltd.—Multi-stage high-frequency amplifiers. 25th June, 1956. (793422.)

20060. General Electric Co.—Steam and gas turbine power plants. 28th June, 1956. (793294.)

20162. Standard Telephones & Cables, Ltd.—Electron tube circuit for frequency separation. 29th June, 1956. (793592.)

22145. Atomic Energy of Canada, Ltd.—Method of and apparatus for detecting breaks in nuclear reactor fuel rod sheaths. 17th July, 1956. (793297.)

25209. Turner, R. G.—Shock-stick or voltage generator rod. 29th October, 1956. (793506.)

26982. Sodeco, Soc. des Compteurs de Geneve.—Amplifier system for telephone networks. 4th September, 1956. (793416.)

29560. Philips Electrical Industries, Ltd.—Germanium diodes. 27th September, 1956. (793417.)

1957

8345. Sylvania-Thorn Colour Television Laboratories, Ltd.—Manufacture of cathode-ray tubes for colour television receivers. 6th October, 1955. (793353.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 19th April:—

RICHARD ALLAN. No. 748,118. Class 9. Loudspeakers, record players, record changers and electric transformers.—Richard Allan Radio, Ltd., Taylor Street, Batley, Yorks.

DURO (design). No. 757,648. Class 9. Switches, sockets, plugs, fuses and push buttons for bells. DURO (design). No. 771,102. Class 11. Shadeholders and lampholders. DURO (design). No. 771,103. Class 17. Insulators.—Busch-Jaeger Dürener Metallwerke Akt.-Ges., Ludenscheid, Germany. Address for service, c/o D. Young & Co., 10, Staple Inn, London, W.C.1.

VIKING. No. 768,404. Class 9. Radio receiving apparatus and record players. LADY ELIZABETH. No. 772,614. Class 9. Radio-telephone, television and telegraphic apparatus, gramophones, and parts; electric batteries; and cases for electric torches and electric lamps.—Vidor, Ltd., 681, Salisbury House, Finsbury Circus and London Wall, London, E.C.2.

POLYGRAMME. No. 770,603. Class 9. Electric and electronic apparatus for use in automatically controlling the operation of industrial apparatus and machinery.—R.P.R. Patents, Ltd., 39-41, New Broad Street, London, E.C.2.

MELETRON. No. 769,883. Class 9. Rotary selector switches, pressure operated switches and vacuum operated switches, all being electrical goods; and solenoid operated valves.—Meletron Corporation, Los Angeles, Cal., U.S.A. Address for service, c/o Mewburn, Ellis & Co., 70-72, Chancery Lane, W.C.2.

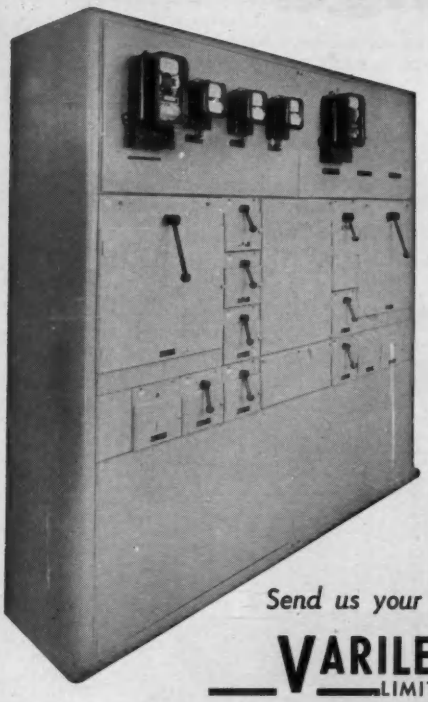
No. 772,762 (design). Class 9. Radio, telephonic, television, telegraphic, sound recording and sound reproducing instruments.—Associated-Rediffusion, Ltd., Television House, Kingsway, London, W.C.2.

RCA (design). No. B758,152. Class 11. Water softening apparatus, electric heaters, refrigerators, milk coolers, incinerators, freezing machines, humidifying installations, gas and electric stoves, drying installations, air conditioning installations, and parts.—Radio Corporation of America, New York, U.S.A. Address for service, c/o A. M. & W. Clark, Quality House, 5, Quality Court, Chancery Lane, London, W.C.2.

AEIRLITE. No. 769,958. Class 11. Lighting installations, appliances and apparatus.—A.E.I. Lamp & Lighting Co., Ltd., Crown House, Kingsway, London, W.C.2.

NELSON'S VICTORY. No. 771,994. Class 11. Electric lamps.—Jan Westerman, Jnr., Hilversum, Holland. Address for service, c/o Barker, Brettell & Duncan, 16, Greenfield Crescent, Edgbaston, Birmingham, 15.

Cubicle Switchboards



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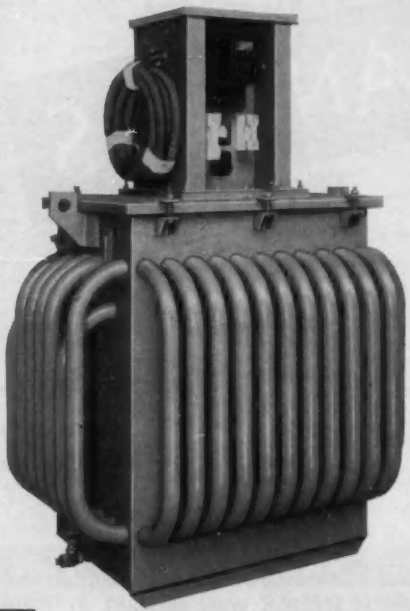

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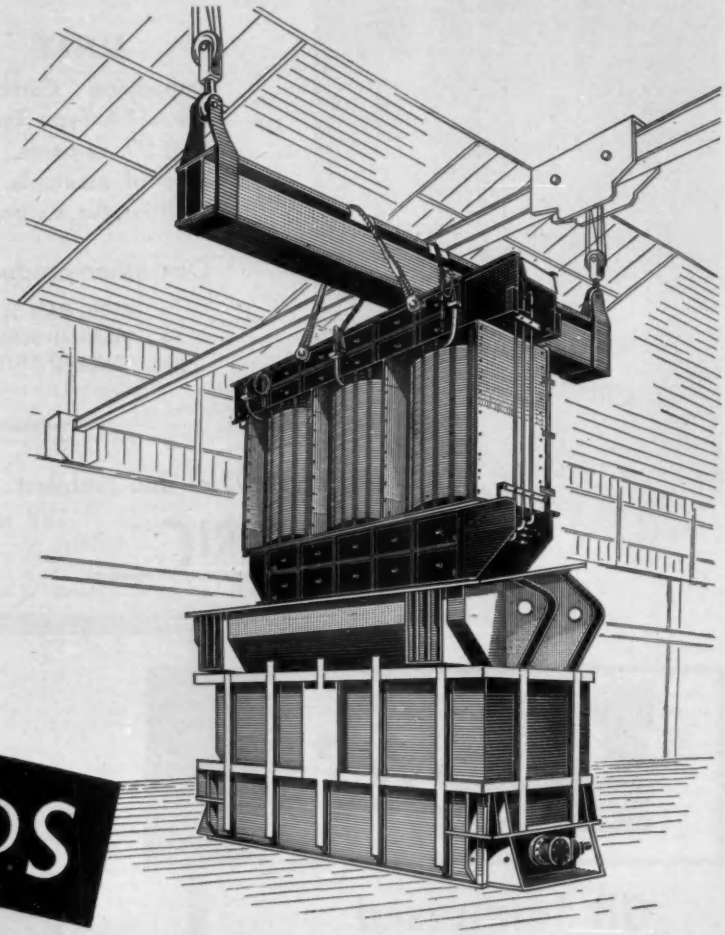

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NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 14th April

CARDIFF.—At the South Wales Institute of Engineers, 6 p.m. I.E.E. Western Centre. "Cathodic Protection," by L. B. Hobgen, K. A. Spencer, and P. W. Heselgrave.

ILFORD.—Angel Hotel, 8 p.m. A.S.E.E. North East London Branch. "Automation in the P.L.A.", by F. W. Sheppard.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. Lecture by G. Hay.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Informal meeting. Discussion on "The Future Trend of Installation Inspection," opened by Forbes Jackson.

White Hall Hotel, Bloomsbury Square, W.C.1, 6.30 p.m. A.S.E.E. Central London Branch. Three short papers.

MALVERN.—Winter Gardens, 7.30 p.m. I.E.E. South Midland Centre. "Developments in Semi-Conductors," by E. G. James.

NEWCASTLE-UPON-TYNE. — Royal Station Hotel, 6.15 p.m. I.E.E. North-Eastern Centre. Annual general meeting and conversazione.

County Hotel, Neville Street, 6.30 p.m. North East Electrical Club. "Electrical Development in Hospitals," by J. Pollock.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.S. Sheffield Centre. Annual general meeting, followed by "The Contribution of Plastics to Lighting Practice," by W. E. Harper.

Livesey Clegg House, 44, Union Street, 7.30 p.m. Junior Institution of Engineers, Sheffield and District Section. "Linear Measurement," by F. E. Clarke.

STONE.—Duncan Hall, 7 p.m. I.E.E. North Staffordshire Sub-Centre. Informal evening on "The Importance of Research in Hearing and Seeing to the Future of Telecommunication Engineering," by Dr. E. C. Cherry.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North West London Branch. "Planned Maintenance," by R. A. Hope.

Monday, 14th April, to Thursday, 17th April

LONDON.—Grosvenor House and Park Lane House. Radio and Electronic Component Show.

Monday, 14th April, to Saturday, 19th April

LONDON.—Earls Court. Factory Equipment, Heating, Ventilation and Thermal Insulation Exhibition.

Tuesday, 15th April

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "An Asymmetrical Induction-Motor Winding for 6:3:2:1 Speed Ratios," by Professor G. H. Rawcliffe and B. V. Jayawant.

CHELMSFORD.—Public Library, 7 p.m. I.E.E. London Graduate and Student Section. District meeting. "The Principles of Electronic Keyboard Instruments," by B. Basham.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "The Mechanical Strength of Power Transformers in Service," by E. T. Norris.

LIVERPOOL.—Liverpool Passenger Transport Office, 24, Hatton Garden, 6 p.m. I.E.S. Liverpool Centre. Annual general meeting.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Utilisation Sections. "A Train Performance Computer," by Professor E. Bradshaw, M. Wagstaff and F. Cooke; "The Simulation of Distributed-Parameter Systems with particular reference to Process Control Problems," by J. F. Meredith and E. A. Freeman; and "A Magnetic-Drum Store for Analogue Computing," by Dr. J. L. Douce and Dr. J. C. West.

Connaught Rooms, W.C.2, Electrical Industries Club, 12 noon. Annual general meeting. 12.30 for 1 p.m. Luncheon. Guest speaker, Sir Christopher Hinton.

London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers. "Factors in the Design of Airborne Doppler Navigation Equipment," by E. G. Walker.

Great George Street, S.W.1, 5.30 p.m. Institution of Civil Engineers. "Construction of Circulating Water Pump House at Cowes Generating Station, Isle of Wight," by R. H. Coates and L. R. Slade.

LOUGHBOROUGH. — Loughborough College, 6.30 p.m. I.E.E. East Midland Centre. Discussion on "The Application of Digital Techniques to Control."

NEWCASTLE-UPON-TYNE. — Crown Hotel, Clayton Street West, 7.30 p.m. A.S.E.E. Tyneside Branch. "Railway Signalling."

READING.—Agricultural Hall, 121, Oxford Road, 7.15 p.m. A.S.E.E. Oxford, Reading and District Branch. "Electrical Ventilation."

Tuesday, 15th April, to Friday, 18th April

HARROGATE.—Royal Hall. British Electrical Development Association. Annual conference.

Tuesday, 15th April, to Saturday, 19th April

TORQUAY.—Palace Hotel. Institute of Metal Finishing. Annual conference.

Wednesday, 16th April

EDGBASTON.—Edgbaston Golf Club, 1 p.m. Birmingham Electric Club. Golf competition.

ERITH. — I.E.E. London Graduate and Student Section. 2.30 p.m. Visit to Post Office Cable Ship, H.M.T.S. *Monarch*.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section (in conjunction with the British Nuclear Energy Conference). "Operational Experience—Calder Hall," by K. L. Stretch.

Café Royal, W, 6.30 for 7 p.m. Dynamicables. Dinner.

Waterloo Bridge House, S.E.1, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "What's Abroad?" by H. E. Francis and C. E. Clinch.

47, Belgrave Square, S.W.1, 6 p.m. Institute of Physics, London and Home Counties Branch. "Heat Transfer Problems of Nuclear Reactors," by W. B. Hall.

MANCHESTER. — I.E.E. North Western Graduate and Student Section, 6.30 p.m. Visit to Process and Insulation Department, Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, followed by "The Science of Electrical Insulation," by J. Hayes.

NORTHAMPTON.—College of Technology, 7.15 p.m. Northampton and District Electrical Association. "Electronic Computers and their Applications to Electrical Engineering," by B. B. Swan.

ROCHESTER.—King's Head Hotel, High Street, 7 p.m. Incorporated Plant Engineers, Kent Branch. "Jointings," by W. H. Hoes.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "The Use of Steel-Tank Mercury-Arc Invertors for Generating Medium Frequencies for Induction Heating," by D. L. Smart and J. J. L. Weaver.

WOLVERHAMPTON.—College of Technology, Wulfruna Street, 7.30 p.m. Institution of Production Engineers, East and West Ridings Region. "Further Review of Electronic Control in Industry," by E. Heys.

Wednesday, 16th April, to Friday, 25th April

LONDON.—Olympia. Instruments, Electronics and Automation Exhibition.

Thursday, 17th April

BLACKBURN.—Golden Lion Hotel, 7.30 p.m. Incorporated Plant Engineers, Blackburn Branch. "Work Study in the Smaller Factory," by P. A. Gibbs.

CANTERBURY.—County Hotel, 7.30 p.m. A.S.E.E. Kent Branch. "Transistors," by F. Szekely.

GLASGOW.—39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. Annual general meeting, followed by films.

Grand Hotel, Charing Cross. Combustion Engineering Association. 10.30 a.m. "Present Practice and the Future of Coal Burning Equipment," by H. E. Pearsall. 2.30 p.m. "Future Developments in Steam Generators," by H. A. Cameron.

LONDON.—2, Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation Section. "2/1 Pole-Changing Motors," by R. F. Burbidge; "Project Considerations for Diesel-Electric Traction," by R. S. Wignall; and "Some Applications of Mercury-Arc Rectifiers," by A. Wren.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Diesel Engineers' and Users' Association. Annual luncheon.

1, Birdcage Walk, Westminster, S.W.1, 6 p.m. Institution of Mechanical Engineers, Applied Mechanics Group. Discussion on "Training in Engineering Design.

MANCHESTER. — Demonstration Theatre, North Western Electricity Board, Town Hall, 5 p.m. Illuminating Engineering Society, Manchester Centre. Annual general meeting and members' night.

Thursday, 17th April, to Sunday, 19th October

BRUSSELS. — Universal and International Exhibition.

Friday, 18th April

BIRMINGHAM. — College of Technology, Gosta Green, 6.15 p.m. I.E.E. South Midland Education Discussion Circle. "Training for the Electrical Trades," by R. W. G. Ward.

LONDON.—Palmerston Restaurant, Bishopsgate, 6 for 6.45 p.m. E.P.E.A. Southern Meter Engineers' Technical Group. Annual dinner.

1, Birdcage Walk, Westminster, S.W.1, 6 p.m. Institution of Mechanical Engineers. Annual general meeting.

Pepys House, 14, Rochester Row, Westminster, S.W.1, 7 p.m. Junior Institution of Engineers. "A Review of P.E.R.A. Activities," by R. L. Hayward.

47, Belgrave Square, S.W.1, 6 p.m. Institute of Physics, Non-Destructive Testing Group. "High-Speed Radiography," by R. F. Thumwood and R. Meakin.

NEWCASTLE-UPON-TYNE. — King's College, 6.30 p.m. I.E.E. North Eastern Graduate and Student Section. Annual general meeting.

SHEFFIELD.—Royal Victoria Station Hotel, 7 for 7.30 p.m. I.E.E. Sheffield Sub-Centre. Annual dinner-dance.

Friday, 18th April, to Monday, 21st April

LONDON.—Waldorf Hotel. Audio Fair.

Saturday, 19th April

GREENWICH.—A.S.E.E. South East London Branch. Visit to Greenwich Gas Works.

MANCHESTER.—A.S.E.E. Liverpool and District Branch. Afternoon visit to Kemsley House.

OXFORD.—Regent's Park College, Pusey Street, 7 p.m. A.S.E.E. "The Building of the Berkeley Atomic Power Station."

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Belfast.—Electricity Department. 2nd May. 33/6·6 kV, 12,500 kVA transformers. (See this issue.)

Bristol.—City Council. 3rd May. Lamps and electrical equipment for the year ending 30th June, 1959. (See this issue.)

Epsom and Ewell.—Corporation. 19th April. Wiring installation at water works. (See this issue.)

Formosa.—Central Trust of China, Taipei. 28th April. Equipment for power transmission system. (E.S.B. 8327/58.I.C.A. Ten/31717.)* 2nd May. X-ray equipment. (E.S.B. 8326/58.I.C.A. Ten/31718.)*

Holywell.—U.D.C. 25th April. Street lighting equipment. (See this issue.)

India.—Director-General of Supplies and Disposals, New Delhi. 23rd April. Street floodlight tower structure. (E.S.B. 8130/58. Ten/31731.)*

Central Water and Power Commission, New Delhi. 25th April. Penstock for the Rongni Chhu hydro-electric project. (E.S.B. 7870/58. Ten/31751.)*

Iraq.—Central Foreign Purchasing Committee, Ministry of Finance. 26th April. Electric spindles and shackle insulators. (E.S.B. 8370/58. Ten/31735.)*

London.—Wandsworth Borough Council. 23rd April. Two schemes of sodium discharge street lighting. (See this issue.)

Morley.—Corporation. 12th May. Street lighting equipment. (See this issue.)

Newark-on-Trent. — Corporation. 30th April. Lighting equipment for Market Place. (See this issue.)

New Zealand.—G.P.O., Wellington. 8th May. Coaxial cable. (E.S.B. 8219/58. Ten/31699.)*

Rhodesia and Nyasaland.—Bulawayo City Council. 88 kV switchgear and associated equipment. (E.S.B. 8229/58. Ten/31716.)*

South Africa.—Stores Department, South African Railways, Johannesburg. 23rd April. Lighting fittings. (E.S.B. 8303/58. Ten/31713.)* 30th April. 6·6 kV, 150 MVA switchboard. (E.S.B. 8306/58. Ten/31723.)*

Union Tender and Supplies Board, Pretoria. 24th April. 150 detectors. (E.S.B. 8455/58. Ten/31762.)* Synthetic resin covers, sockets and plugs. (E.S.B. 8501/58. Ten/31761.)* 150 transformers. (E.S.B. 8502/58. Ten/31756.)*

Sudan.—Department of Posts and Telegraphs, Khartoum. 17th May. Inert or air depolarised cells. (E.S.B. 8379/58. Ten/31738.)*

Todmorden.—Corporation. 18th April. Rewiring of the Town Hall, and supply of lighting fittings. (See this issue.)

ORDERS PLACED

Ilford. — Corporation. Recommended. Electrical rewiring of 48 maisonnettes on the Duke Road estate (£1,950).—B. Winters & Son.

Sheffield.—Corporation Housing Committee. Communal electrical services required for the dwellings comprised in Part 1 of the Park Hill redevelopment area (£19,762).—Yorkshire Electricity Board.

Regional Hospital Board. Recommended. Electrical services at Middlewood Hospital (£4,300).—T. W. Sampson & Co.

Southampton. — Corporation. Recommended. Renewal of the electrical installation at the Itchen Grammar School (£5,629).—I. Groves & Co.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Bedford.—Improvements to Newnham Swimming Baths (first stage to cost £59,800); F. W. Dawkes, borough engineer, Newnham House, Horne Lane.

Birkenhead.—Houses (480), Farlow Road, Grosvenor Street, Mersey Mount, Oxton Road and Woodchurch; borough architect, 3, Conway Street.

Birmingham.—Business premises covering site bounded by Temple Row, Cherry Street, Corporation Street and Bull Street (£3,500,000) for Harrods, Ltd.; Taylor Woodrow Construction, Ltd., Adrienne Avenue, Southall.

Six-storey office block, Hagley Road, Edgbaston, for Tube Investments, Ltd.; Cotton, Ballard & Blow, architects, Cavendish House, Waterloo Street.

Blackburn.—R.C. church at Langho; T. Sumner Smith & Partners, quantity surveyors, 4, St. Anns Square, Manchester, 2.

Blackpool.—Primary school and health centre, Anchorsholme, and school for educationally sub-normal children at Marton (£54,000); A. S. Hamilton, borough engineer, Municipal Offices.

Blaydon (Co. Durham).—Houses (50), Rowlands Gill; U.D.C. surveyor.

Bognor Regis.—Home for the blind at Aldwick (£25,000); West Sussex county architect, County Hall, Chichester.

Boldon.—Houses (94), Wellands Lane, for U.D.C.; J. T. Edmondson, surveyor.

Border.—Houses (30), Brampton; R.D.C. housing officer, 7, Victoria Place, Carlisle.

Brechin.—Houses (30), Mountskip Road; Scottish Special Housing Association, Ltd., 15/21, Palmerston Place, Edinburgh, 12.

Brighton.—Works, Hollingbury; S. M. Tidy, Ltd., 161, Preston Road.

Bristol.—Showrooms and offices, Penn Street; C. & A. Modes, Ltd., North Row, Oxford Street, London, W.1.

Burton-on-Trent. — Out-patients' and casualty department for General Hospital; Birmingham Regional Hospital Board, 10, Augustus Road, Edgbaston, Birmingham.

Calne and Chippenham.—Houses (100) for Admiralty employees; R.D.C. surveyor, Bewley House, Marshfield Road, Chippenham.

Cardiff.—Flats, Lady Mary Road; T. Elvet Llewellyn, architect, 59, Queen Street.

Chapel-en-le-Frith.—Further stage of new technical buildings for Ferodo, Ltd.; Ashworth & Fletcher, architects, Walk Chambers, Yorkshire Street, Rochdale.

Cleckheaton.—Extensions to Whitcliffe Mount Grammar School (£192,249); George Horsfall & Son, builders, Valley Road, Liversedge, Heckmondwike.

Corby.—Second phase of Technical College (£244,054); Ambery, Ltd., Geddington, Northants.

Coventry.—Factory and offices, Swan Lane; L. Dainty, Ltd., builders, Leighswood Drive, Aldridge.

Crosby.—Houses (102) with community centre, Brownmoor Lane estate; borough surveyor.

Croydon.—Public baths, Morland Road and Lower Addiscombe Road; borough engineer.

Extensions, Castle Hill Junior School; Truett & Steel, Ltd., builders, 71, High Street, Thornton Heath.

Dorchester.—Houses (200); borough surveyor.

Duston.—Houses (290); Chowns, Ltd., builders, 63, Edinburgh Road, Northampton.

Edinburgh.—Buildings for Department of Engineering, Mayfield Road (£300,000); Todd & Ledson, quantity surveyors, Victoria Buildings, Hackins Hey, Liverpool, 2.

Glendale.—Houses (38), Golden Square, Wooler; A. R. Field, surveyor, Council Offices, Wooler.

Hendon.—Rebuilding and adaptations, Garden Suburb School (£36,758); borough engineer, Town Hall, N.W.4.

Hull.—Factory premises, Reform Street; A. E. Jenkinson, Ltd., builders, Dunswell Road, Cottingham.

Inverness.—Extensions to County Offices, Ardross Street (£100,000); county architect.

London.—Reinstatement of St. Andrew's Church, rectory and courthouse, Holborn Viaduct; Seely & Paget, architects, 41, Cloth Fair, E.C.1.

Office block, High Holborn; H. G. Potter & Sons, builders, 6, Kingswood Road, S.W.19.

Church, Lower Road and Culling Road, Rotherhithe; Spalding, Myers & Attenbrow, architects, 12, New Court, Carey Street, W.C.2.

Secondary school (£345,000), Kenninghall Road, Clapton; Edward Armstrong & Frederick Macmanus, architects, 28, Gloucester Place, W.1.

Office block, Queen Street, Mayfair; Arthur Swift & Partners, architects, 21, Upper Grosvenor Street, W.1.

Loughborough.—Five blocks of flats in Victoria Street (£84,000); borough surveyor.

Merionethshire.—Practical instruction block (£60,000), Ysgol School, Ffestiniog; county architect, County Offices, Dolgelley.

Newcastle-on-Tyne.—East Newcastle Boys' Technical School (£132,000); Tarslag, Ltd., builders, Tees Bridge, Stockton-on-Tees.

Northumberland. — Grammar Technical School at Ashington (£195,000); R. W. Bell & Co., builders, Jesmond, Newcastle-on-Tyne.

Secondary school at Allendale; Newman & Sons, Ltd., builders, Eastgate, Hexham.

Rugby.—Shops, Newbold Glebe estate; borough surveyor.

Sheffield.—Modernisation of Middlewood Hospital (£170,000); Regional Hospital Board, Fulwood House, Old Fulwood Road, Sheffield, 10.

Spalding.—Blocks of three-storey flats, Andrews Yard, Roman Bank; U.D.C. architect, Spalding, Lincs.

Stourbridge.—Houses (80) and flats (36), Wollaston Farm estate (1958 programme); borough engineer, Council House.

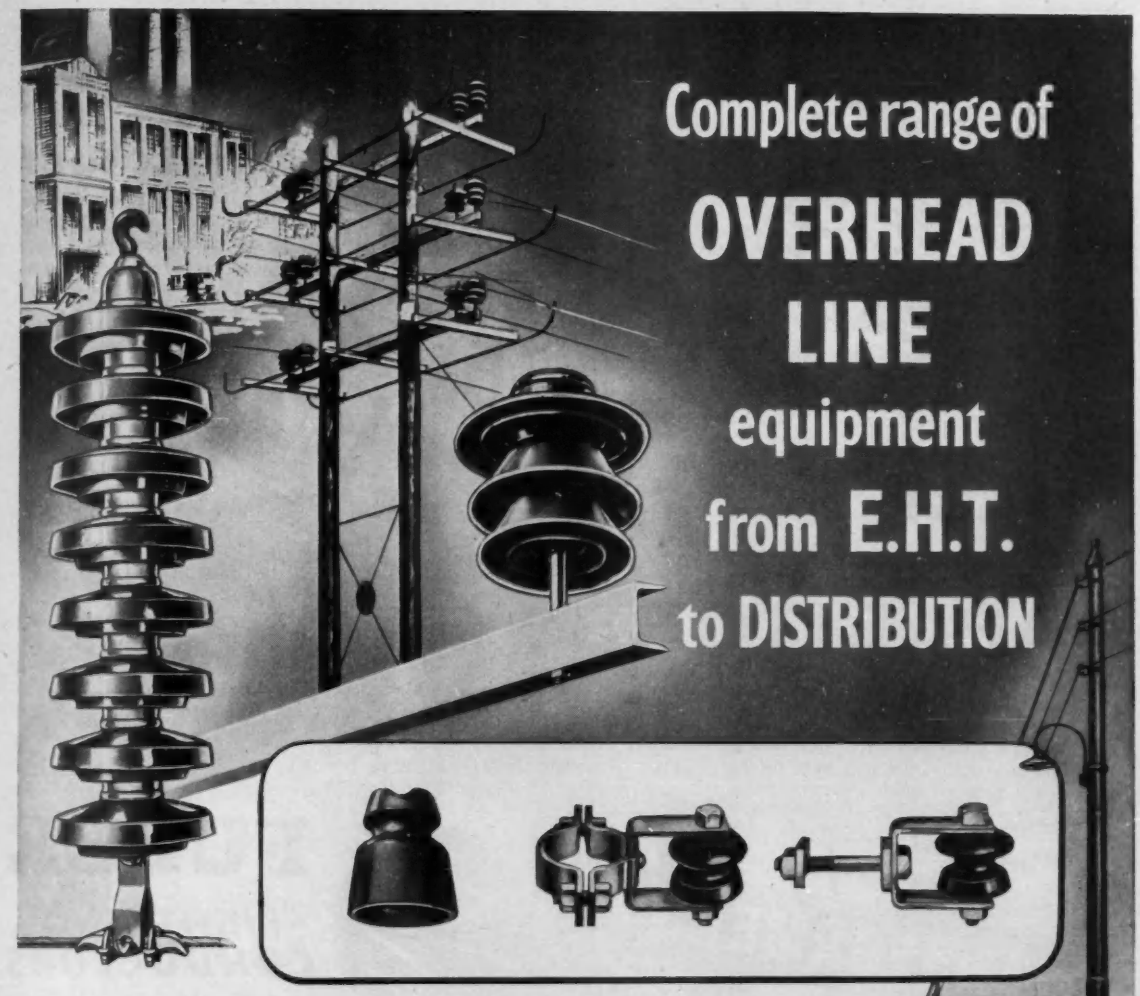
Tynemouth.—Houses (204), Coast Road extension; M. J. Liddell & Sons, builders, Great North Road, Newcastle-on-Tyne.

Bungalows (35), near Hartburn Road; J. H. Rogers, builder, Regent Terrace, North Shields.

Wolverhampton.—Three 11-storey blocks of flats in the Vauxhall area (£350,000) and second stage of Dale Street scheme (11-storey flats); J. Brock Allon, town clerk, Town Hall.

Residential special school on site at Kingswood Common, Wrottesley (£106,440); direct labour department, Low Hill.

Worcester.—Primary school, Warndon; Henry G. Gorst, architect, 97, High Street.



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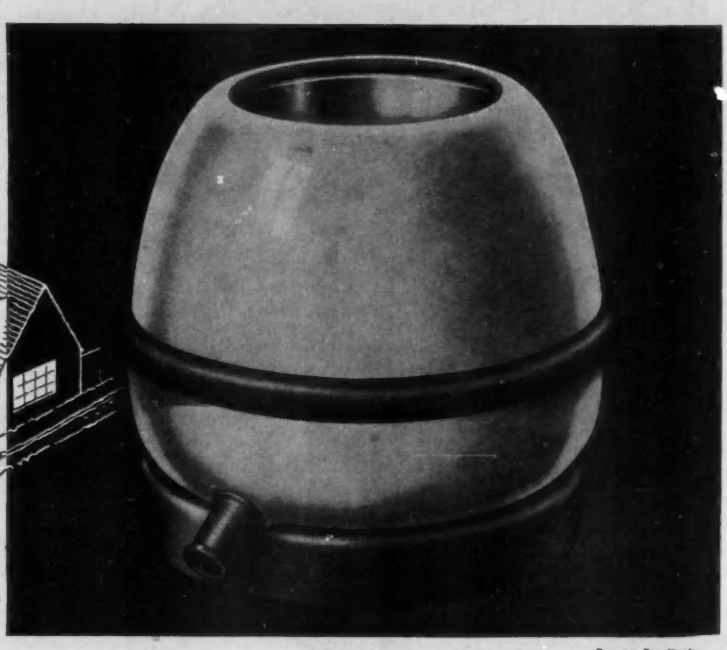

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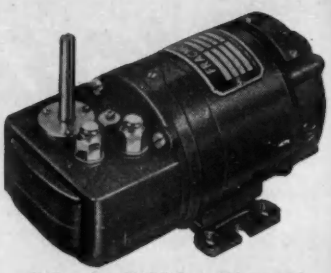

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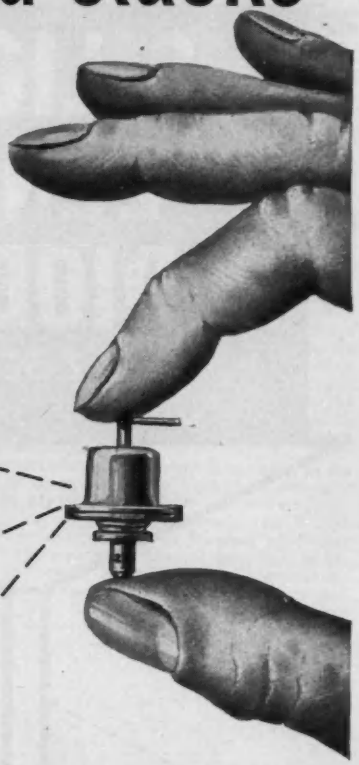

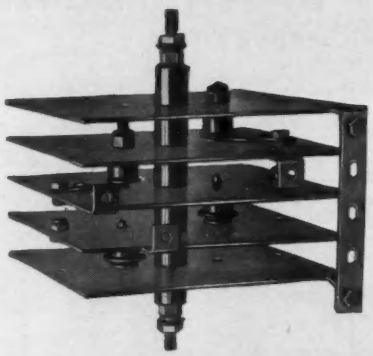

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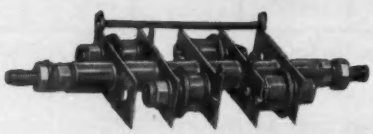

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Z2A33	3.3	Z2A33	3.3		
Z2A36	3.6			Z2A33	3.3
Z2A39	3.9	Z2A39	3.9		
Z2A43	4.3				
Z2A47	4.7	Z2A47	4.7	Z2A47	4.7
Z2A51	5.1				
Z2A56	5.6	Z2A56	5.6		
Z2A62	6.2				
Z2A68	6.8	Z2A68	6.8	Z2A68	6.8
Z2A75	7.5				
Z2A82	8.2	Z2A82	8.2		
Z2A91	9.1			Z2A100	10
Z2A100	10	Z2A100	10		
Z2A110	11				
Z2A120	12	Z2A120	12	Z2A150	15
Z2A130	13				
Z2A150	15	Z2A150	15		

Characteristics and ratings of *SenTerCel* Zener Diodes are given in publication SIL/103A

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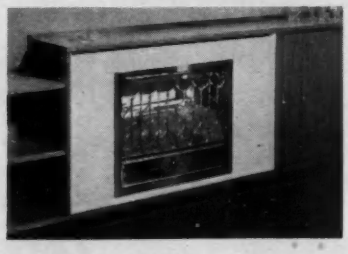
ALL-ELECTRIC HOUSES ARE HERE

ABOVE: These are some of the All-Electric Houses on an estate under development at Woking.

LEFT: The Ferranti Fridge-Heater provides constant hot water and a refrigerated larder.

BELOW: Ferranti Panel Fires provide an attractive focal point-of-interest.



You can't afford to miss these new developments

These are houses of the future. They will be up-to-date in 1980. Why? Take a look at the roofs—there are no chimneys. These are all-electric houses on an estate which is being developed in Woking. They have a domestic heat pump installed for providing constant hot water and a refrigerated larder. Central heating is provided either by built-in convector heaters or by heating cables buried in solid floors. This latter type of heating gives an evenly spread heat throughout the house and the power may be taken at night when special off-peak rates are available. The absence of chimney breasts and flues means no more draughts and additional space.

The latest types of insulating materials are used in the construction of these houses, for example, lightweight concrete blocks are used for the inner walls and insulation round the edges of the floors prevent loss of heat through the walls. Roof insulation is also provided which cuts down one of the greatest sources of heat loss in any house. And the cost? The capital and running costs are actually less for this type of house than for a conventional one. The all-electric house is here to stay. Look at the tables below; the savings shown are taken from actual figures in the all-electric houses at Woking.

CAPITAL COSTS

All-Electric House	£ s. d.
Fridge-heater	159 12 7
Floor warming cable installation	90 0 0
Living room, radiant fire	18 17 8
Bathroom, radiant fire	5 5 0
Bedroom, radiant fires (three)	20 15 3
Extra wiring and labour	15 0 0
	£309 10 6

Conventional House	£ s. d
Refrigerator, 4 cu. ft ...	80 0 0
Two chimneys and coal bunker	136 0 0
Flashing, chimney soakers	10 0 0
Tiler and carpenter ...	7 0 0
Ducts in floor	1 10 0
Slow burning grate and surround	50 0 0
Five radiators and valves	21 5 0
Towel rail	10 0 0
Boiler and pipes ...	50 0 0
Tubing and plumber's labour	70 0 0
Decorators	3 0 0
	£438 15 0

SAVING BY ELECTRIC METHOD

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Average total running costs for a 3-bedroomed house (water heating, space heating, lighting, cooking and accessories) average between £50-£60 p.a.

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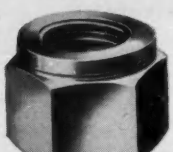

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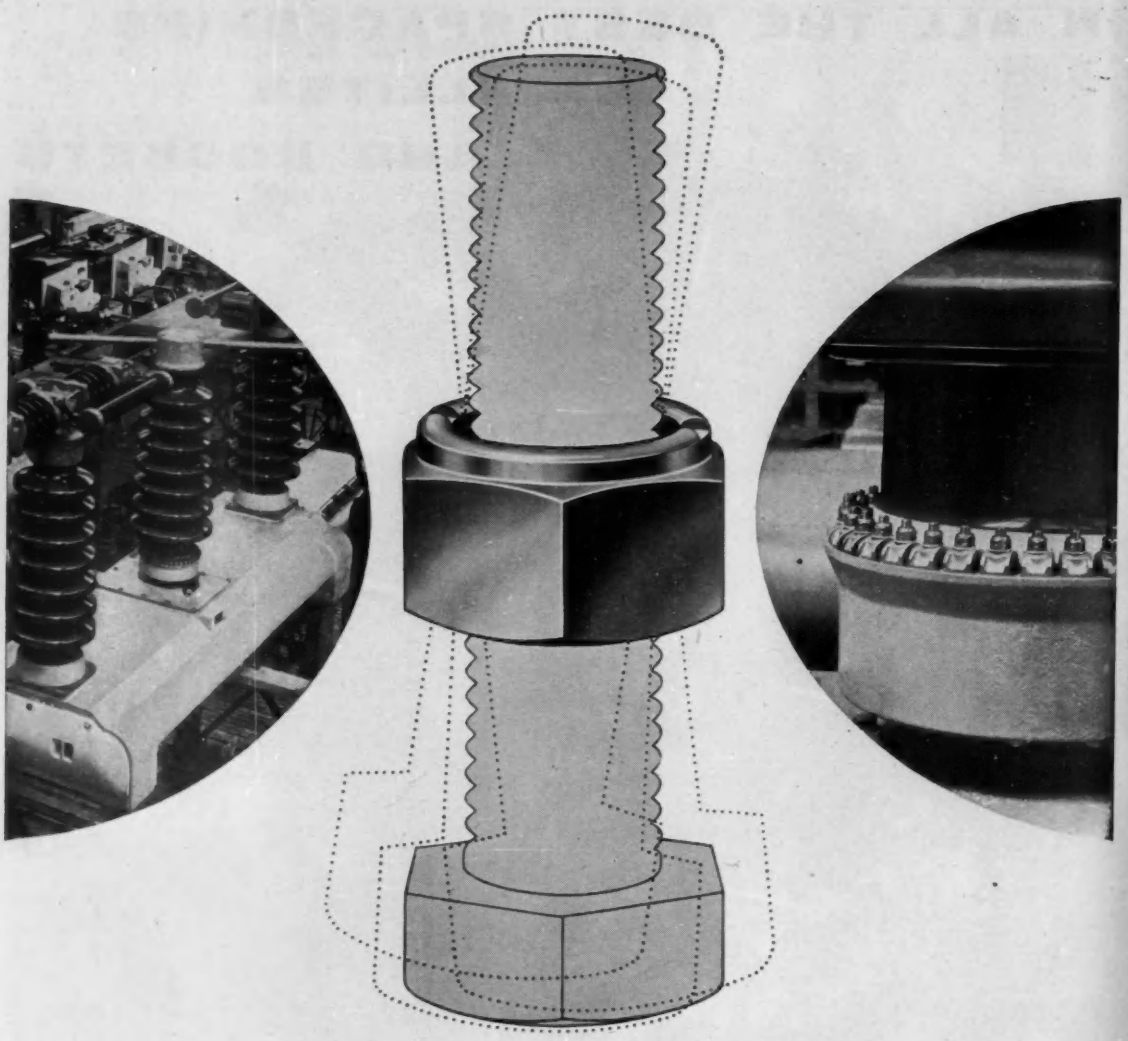

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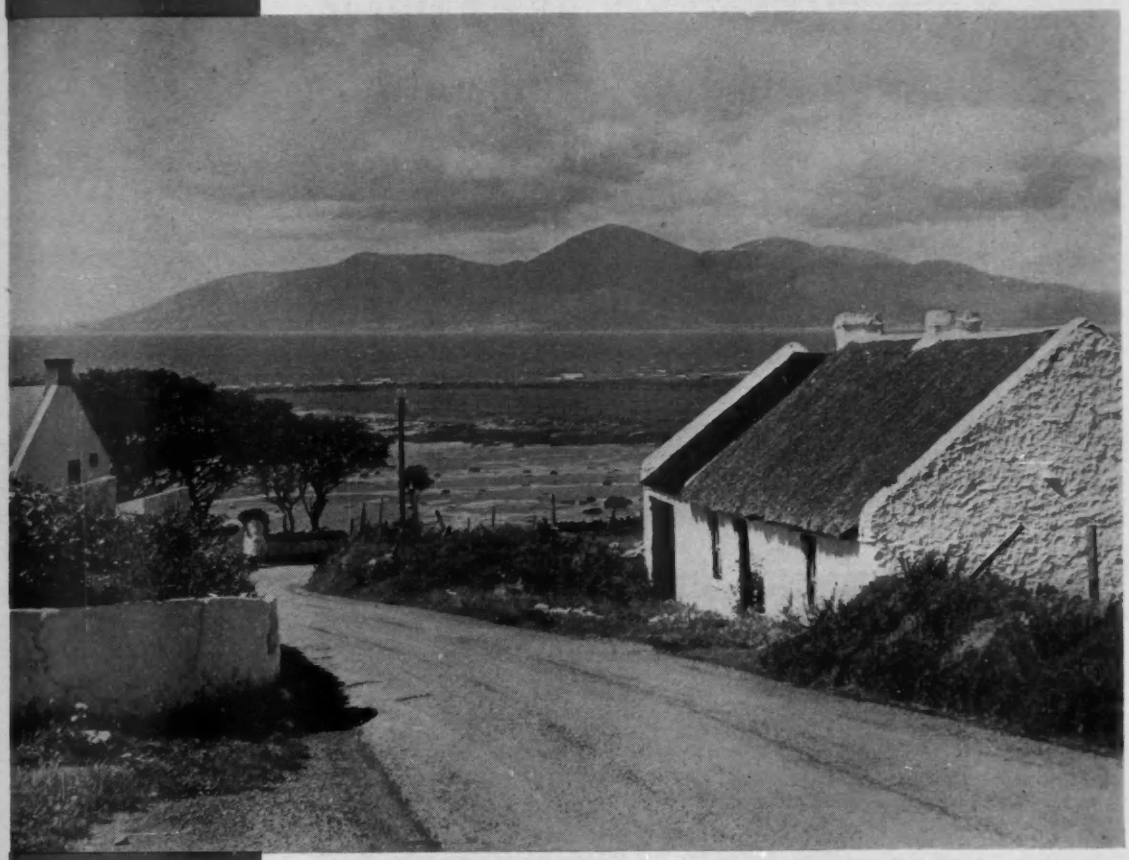
'Tis distance lends enchantment to the view,
And robes the mountain in its azure hue.

(Pleasures of Hope by Thomas Campbell)



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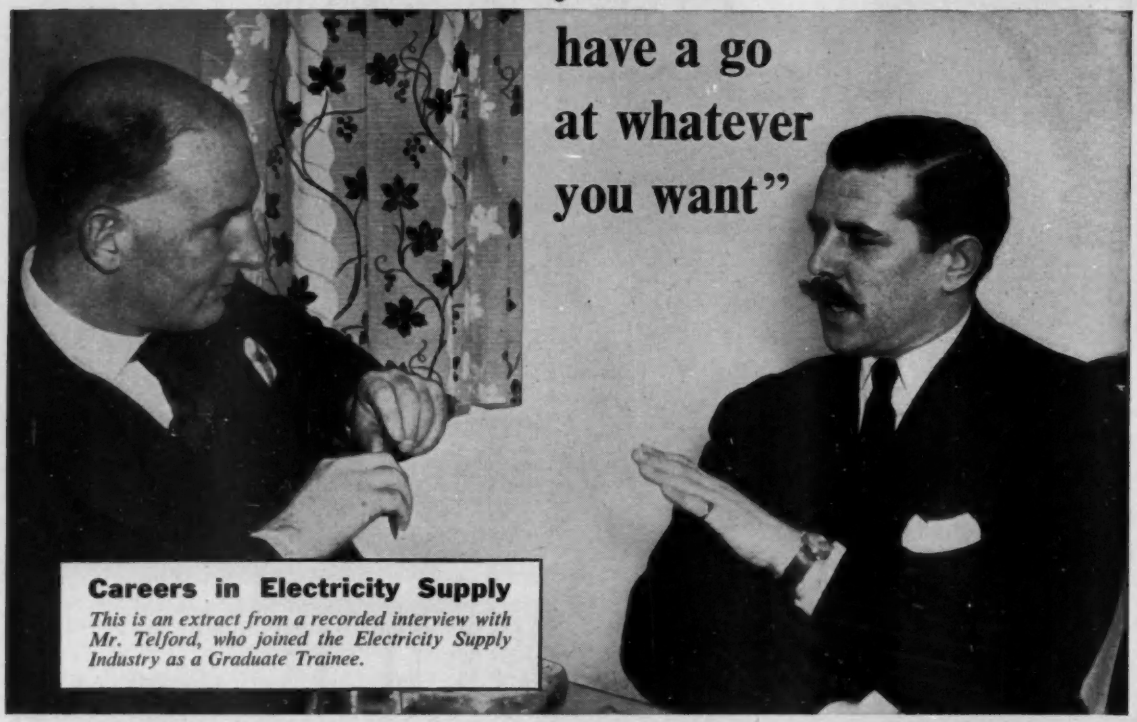

Careers in Electricity Supply

This is an extract from a recorded interview with Mr. Telford, who joined the Electricity Supply Industry as a Graduate Trainee.

E.S.I. Question Master — *Mr. Telford.*

Question Master: **I think we might begin by asking what was your first job in Electricity Supply after your training was finished?**

Mr. Telford: Well, my training was interrupted by the war, and it was only in 1950 that I finished my graduate course in the industry. I was then appointed Shift Charge Engineer at Frome, Somerset—a small station but an excellent training ground. From there I went to Earley—a much bigger station of 120 megawatts—as Boiler House Shift Engineer; later I became Charge Engineer there, and for a while was Efficiency Engineer, as well.

Q.M.: **Your next step was London, wasn't it?**

Telf: Yes, I came to London as Second Assistant Engineer on the Divisional Staff, and later I was appointed Deputy Superintendent at Bankside Generating Station—the position which I hold now.

Q.M.: **Bankside is a pretty big station, and at 36 you're young, aren't you, to be a Deputy Superintendent? But what made you come to London in the first place?**

Telf: A chance came along to get some administrative experience at H.Q. level, and I thought I'd better take it.

Q.M.: **Does the Industry give many opportunities like that?**

Telf: It most certainly does. It gives you a complete opportunity to have a go at whatever you want, and what you think you're best equipped for. The man who wants to get on is helped in every possible way; I've attended several courses run by the Industry, not only on technical matters, but on subjects like personnel selection and industrial relations.

Q.M.: **You find your job gives you scope for managerial ability—dealing with people as well as machines?**

Telf: Yes, indeed. I don't think there are many better opportunities than in a power station, because you have something of everything. You have the mechanical side, the electrical side, the building side—and most of all, a number of people with varied interests and jobs.

Q.M.: **Now a word about newcomers to the industry. If you have a chap of ability who is prepared to get down to the task, what would you say his opportunities were like?**

Telf: I would say that he has really splendid opportunities. For one thing, a career in the industry is established on a very firm footing—you could do without a lot of things, but it's impossible to get on nowadays without electrical energy. Another point worth remembering is that a man coming into the industry has the choice of the entire country to work in, and there's no parochial approach.

We'd like to publish more of this interview, but there isn't space. For details of the many careers in the Electricity Supply Industry and the salaried training schemes available ask at your local Generating or Distribution Board's offices, or write direct to:

The Education and Training Officer,
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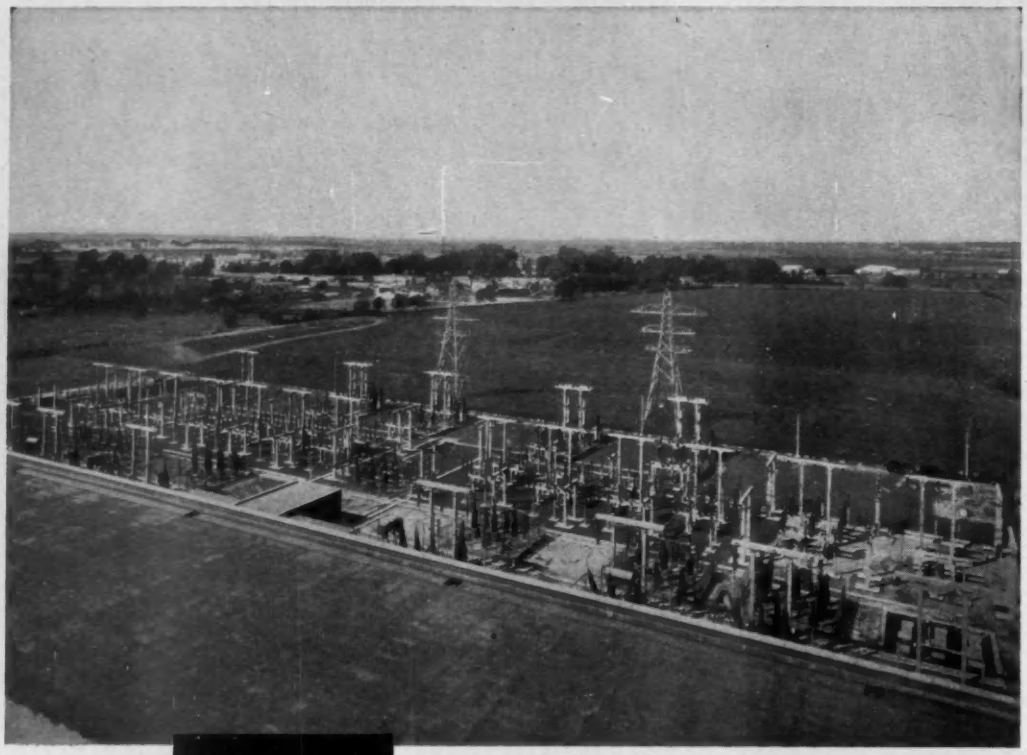

GOLDINGTON POWER STATION

Consulting Engineers : Messrs. Merz and McLellan

Photograph by courtesy of the CEGB Eastern Division

The main 132-kV 2500-MVA air-blast switchgear with its associated control-equipment as well as the 3·3-kV oil-break switchgear and 415-volt air-break switch and fuse gear for the station auxiliaries at Goldington Power Station was supplied by Reyrolle.

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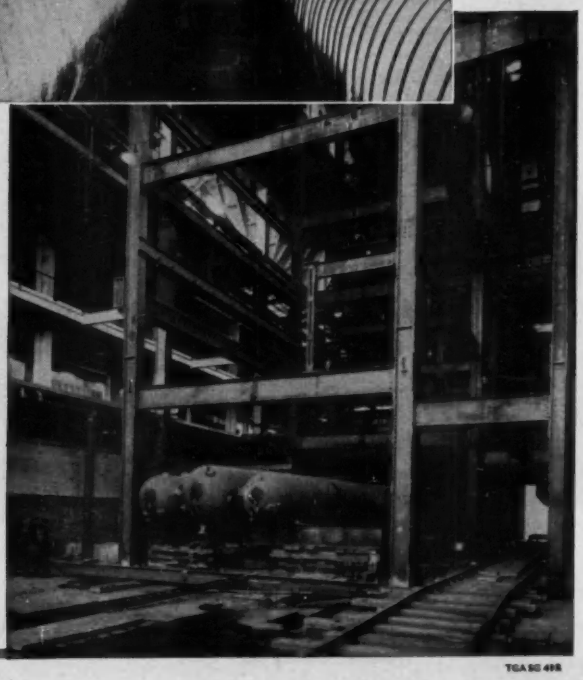

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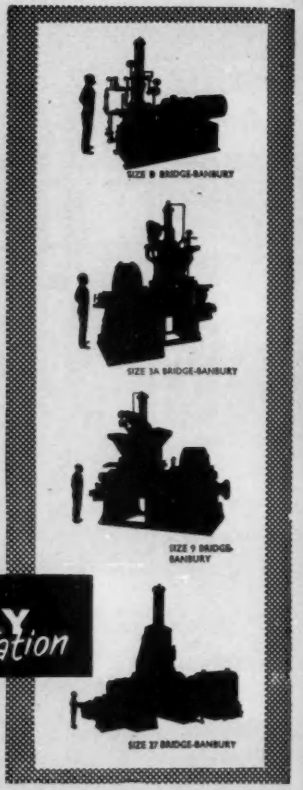

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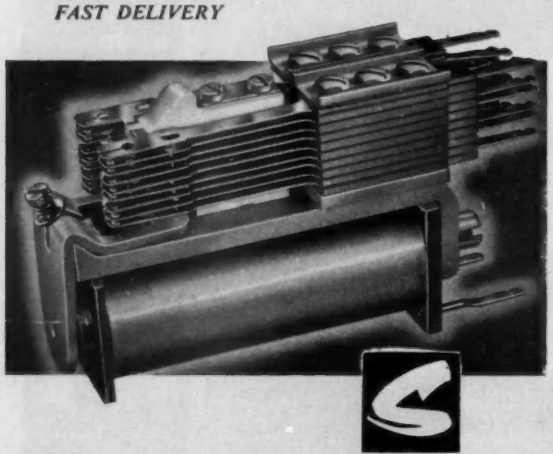

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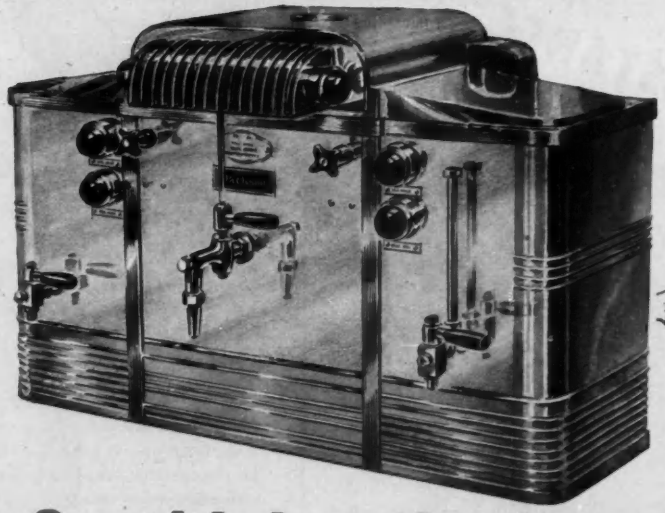

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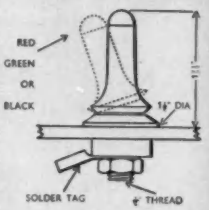

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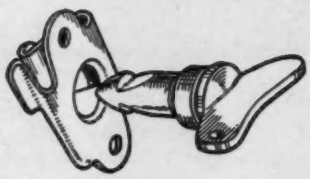

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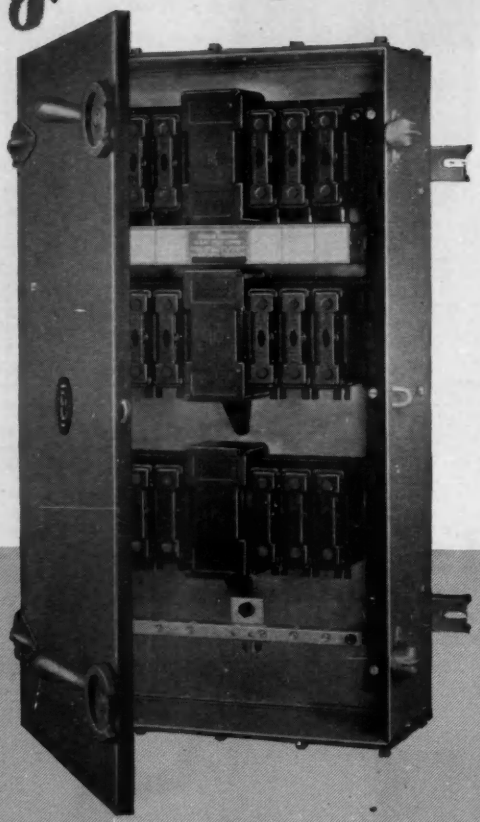

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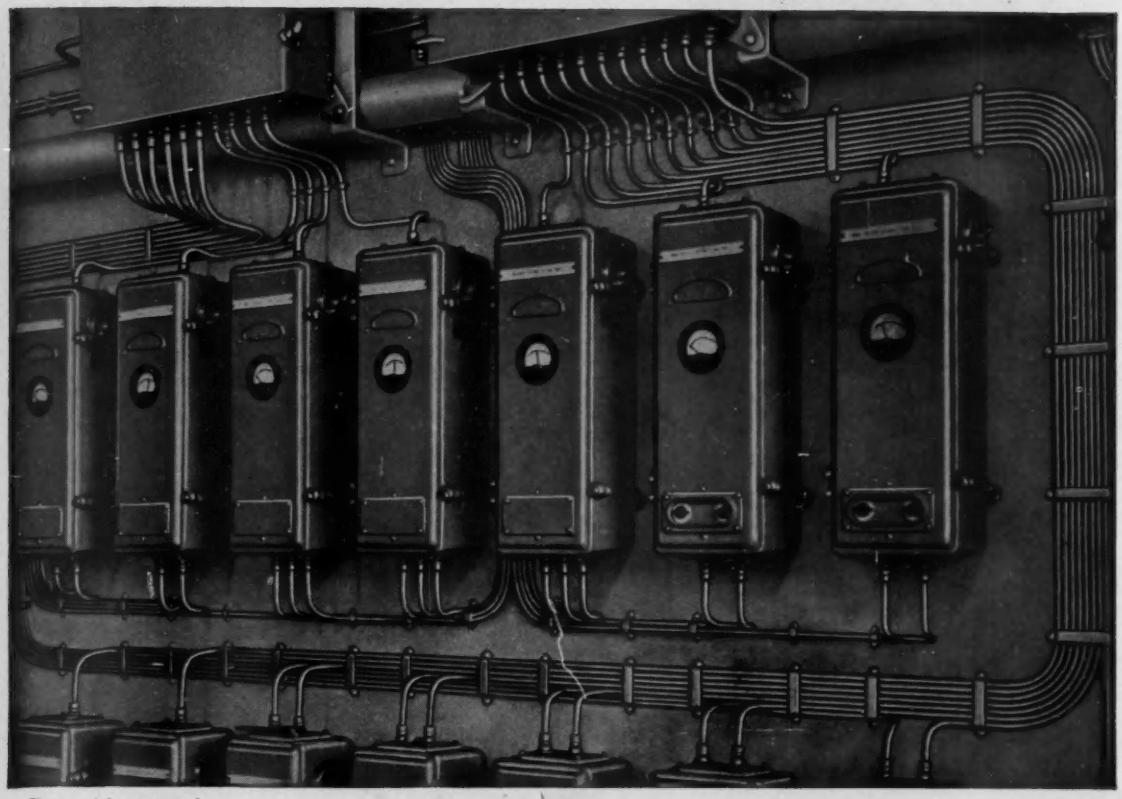

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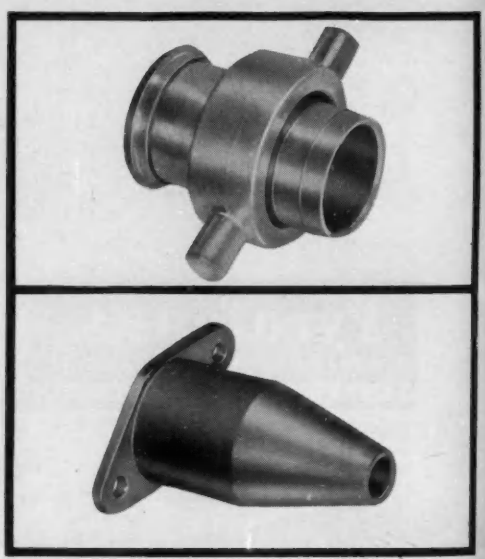

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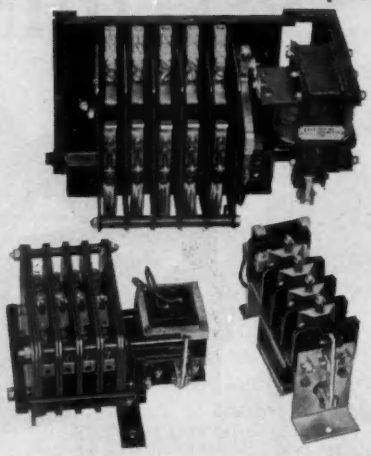

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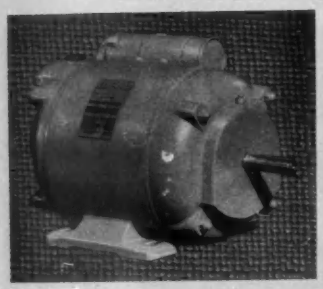

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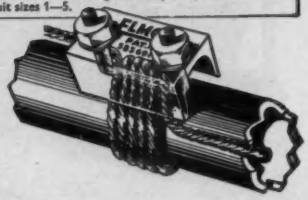
A COMPLETE RANGE TO B.S.951. 1948 IN 4 SIZES

	A123	B45	C67	D8910
for earthing cables up to	7/0.036"	7/0.064"	19/0.064"	19/0.083"
to fit B.S. conduit sizes	1, 2 & 3	4 & 5	6 & 7	8, 9 & 10
i.e. in trade terms	¼" to ⅜"	1" and 1¼"	1½" and 2"	2½" to 3½"

NOTE ALSO: Type A123 is suitable for Earthing Cables up to 7/0.029" and for B.S. conduit sizes 1—5.



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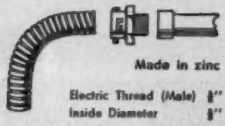

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Inside Diameter	⅜"	½"	1"	1¼"	1½"	2"
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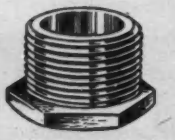

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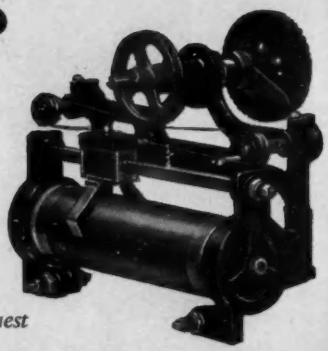

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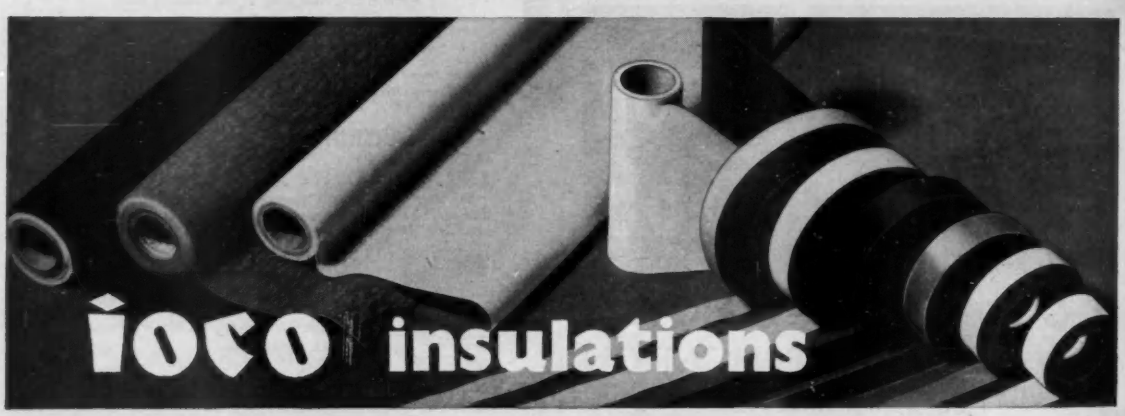

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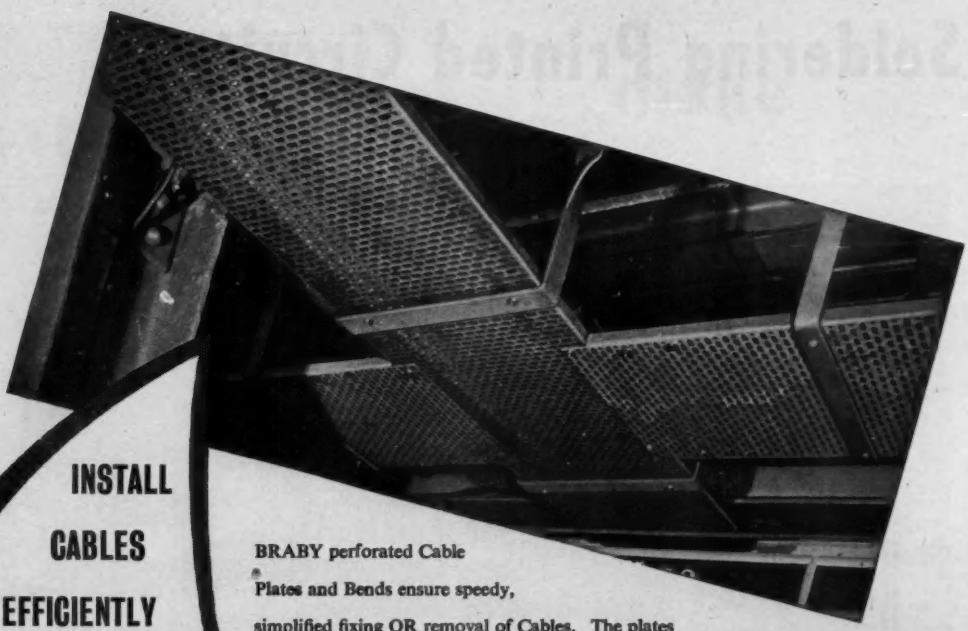

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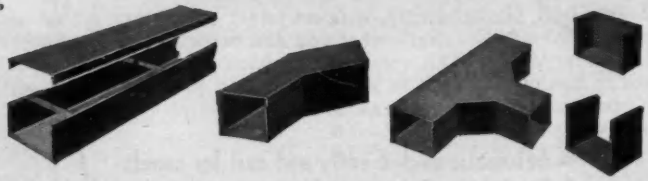

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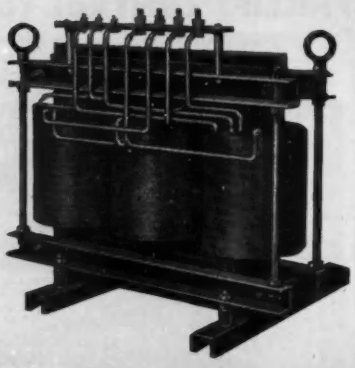

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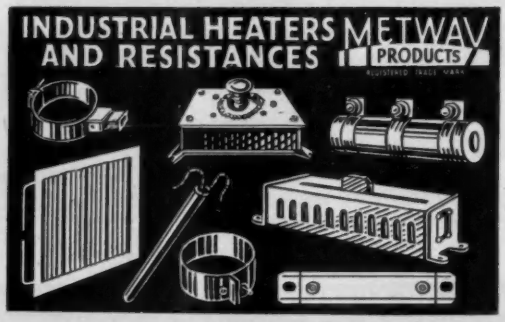

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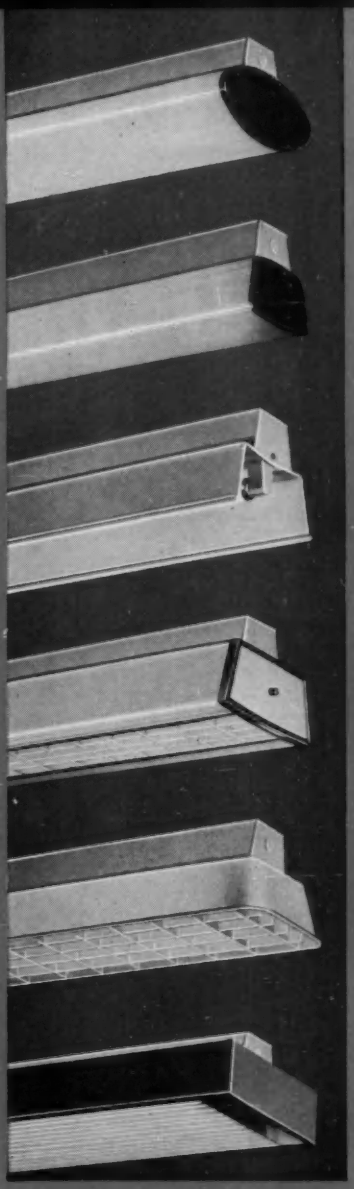

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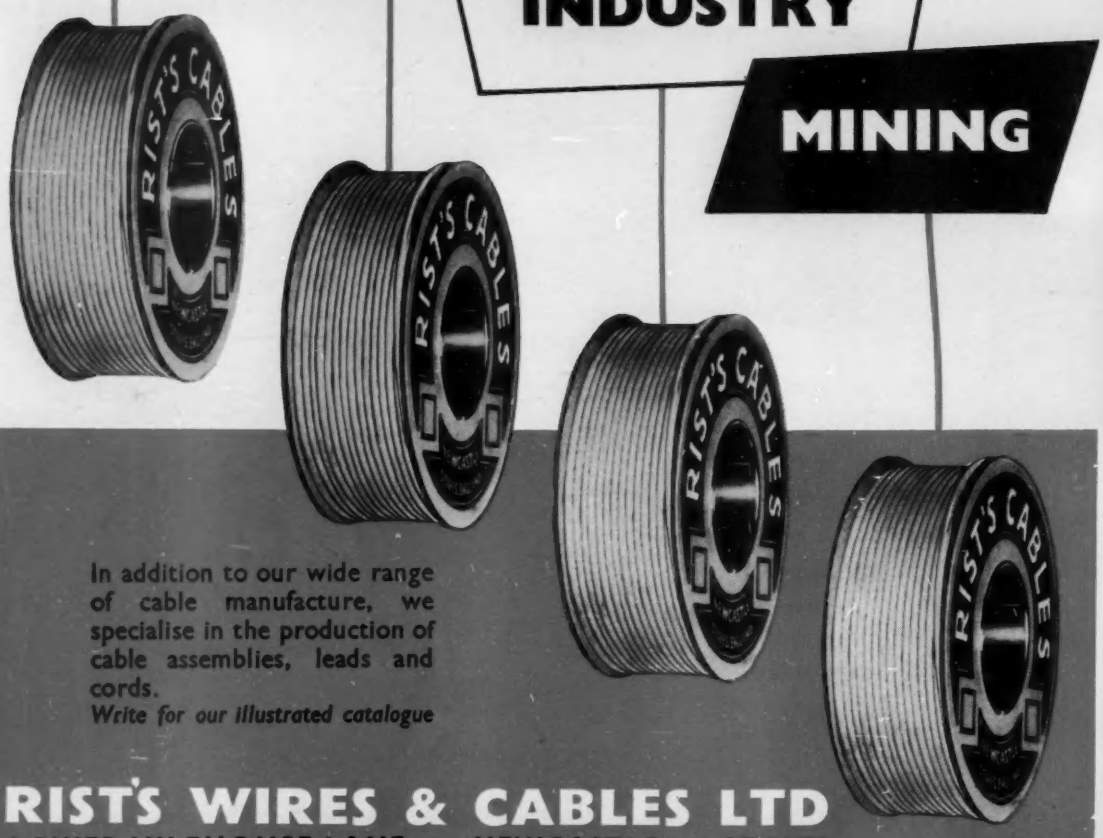

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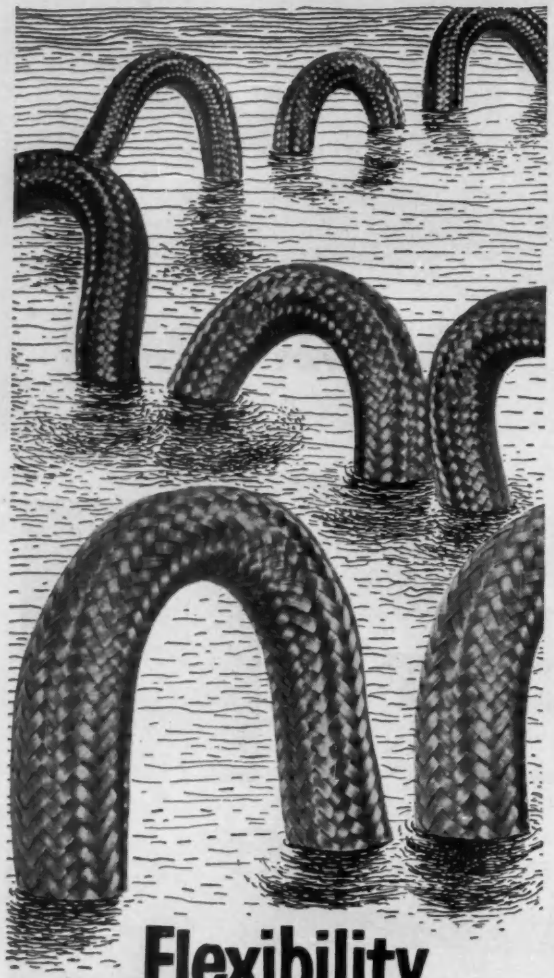

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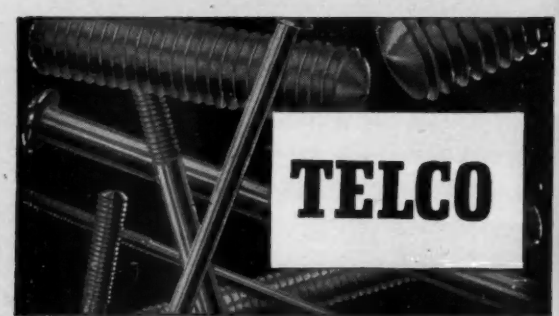

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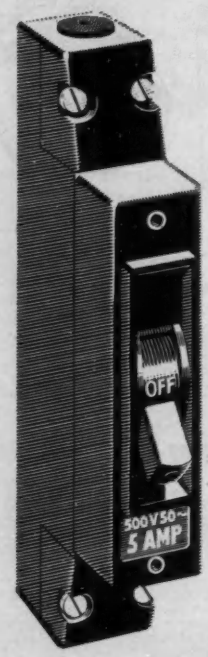

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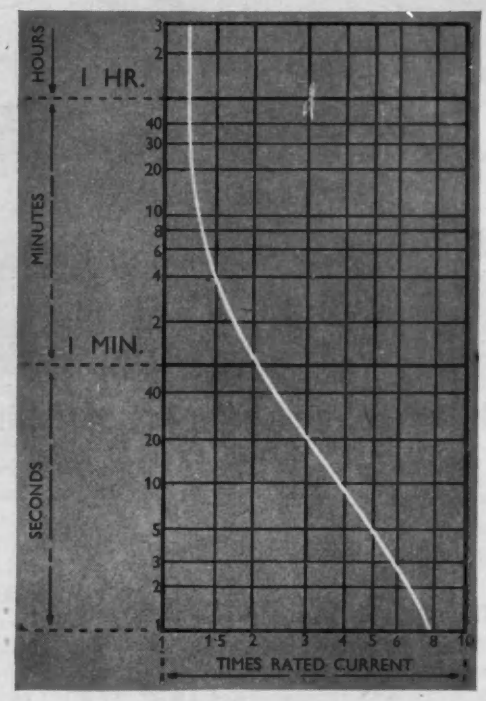

Characteristic tripping curve for 60 amp. overload release.

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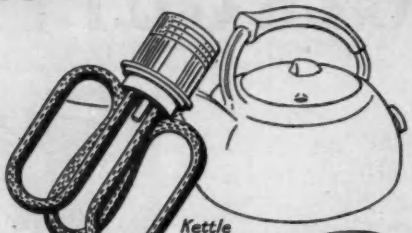
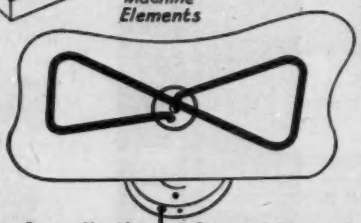
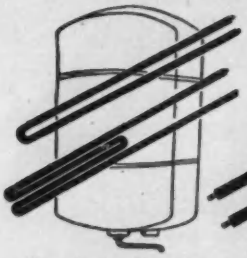


Kettle Elements

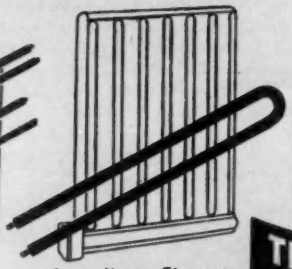
Fan Heating Elements



Space Heating Infra-red Elements



Water Heater Elements



Space Heater Elements

THE TETRA ENGINEERING CO. LTD
1-3 Redhill Street, London, N.W.1 Tel. EUSton 3707 PS.61

QUICKWAY

MDC LTD

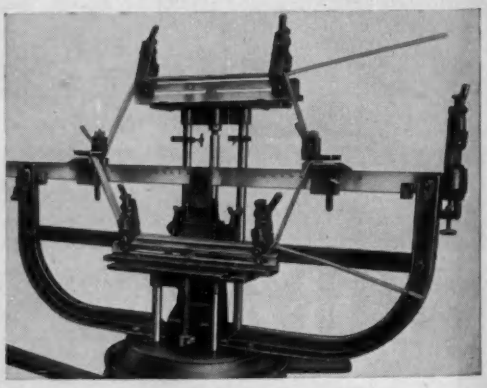
Coilwinding and forming machine

is used by leading manufacturers and repairers of electrical equipment and produces a wide range of uniformly shaped armature and stator coils.

The standard machine produces formed coils up to 28 in. loop length. Additional attachments can increase the range up to 42 in. loop length.

Also available in the "QUICKWAY" range are armature winding and taping machines.

Send for further details to the "QUICKWAY" Department.



THE MIDLAND DYNAMO CO. LTD.

QUICKWAY WORKS - LEICESTER - Tel. 20172 (5 lines) Grams: "DYNAMO" LEICESTER

Rotary Transformers

NELCO rotary transformers

. . . provide lightweight, long life power supplies for battery-operated telecommunication equipment. DESIGN APPROVED by M.O.S., NELCO rotaries comply with the stringent requirements of specifications E.L. 1082, R.C.S.11 and K.114. All NELCO Rotaries are wound with Class "B" insulation as standard and exceptional care is taken over performance and finish. NELCO moulded commutators using mica or micanite separators are used throughout and single, double or triple outputs can be provided. The standard range covers from 15 to 400 watts output but enquiries for rotaries outside this will receive careful attention.

NELCO
LIMITED

A.I.D. and A.R.B. Approved

STATION ROAD, SHALFORD, SURREY. Phone: GUILDFORD 5336/7/8

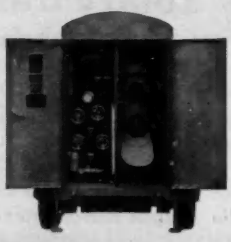
N.15

More than 25 years experience

OF UPGRADING INSULATING OIL

For more than a quarter of a century Metafilters have been accepted by electrical engineers for the COLD upgrading of switch and transformer oils, thus ensuring absolute removal of solid impurities however finely divided, together with dehydration without recourse to heating and/or vacuum. Electrical and consulting engineers, well-known oil companies, generating and distributing organisations, manufacturers of transformers and switchgear have chosen the Metafilter because (a) COLD filtration effects removal of impurities otherwise soluble in hot oil, (b) high di-electric strength and (c) no costly expenditure on replacement papers or sheets.

Metafilters for transformer and switch oils are available as static, portable and fully mobile units with capacities from 50 g.p.h. to 1,000 g.p.h.



Metafilter

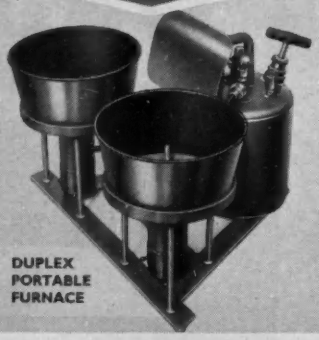
'PURITY WITH SIMPLICITY'

THE METAFILTRATION CO. LTD
BELGRAVE RD. HOUNSLOW, MIDDX
Phone: HOUnslow 1121-3

TRADE MARK

Sheen

CABLE JOINTING EQUIPMENT FOR EXTRA EFFICIENCY
plus reliability



DUPLEX PORTABLE FURNACE

HUGH PRICHARD & CO (Nottingham) LTD
Greasley Street, Bulwell, Nottingham. Telephone 27-1437.

THE MERITUS

HIGH CURRENT NEUTRAL LOOP IMPEDANCE AND CONTINUITY TESTER

SHOCKPROOF AND SAFE FOR OPERATOR AND INSTRUMENT

This instrument will SAFELY carry out tests on electrical installations and appliances as recommended in the I.E.E. Regulations, 13th Edition, 1955, Section 5.

MERITUS (BARNET) LTD.
BARNET, HERTS. **Bar. 2291/2**

TEMPERATURE CONTROL

by

THE THERMOSTATIC CONTROLS CO.

WE shall be pleased to submit special designs for all domestic and commercial applications, including combination units of heater and thermostat, or safety device.

HEATING ELEMENTS

by

CONTROLLED HEATING UNITS (London) LTD.

Obtainable, complete or separately, from the same factory.

Enquiries to :—

AVENUE ROAD • HAMPTON • MIDDLESEX TEL. MOLESEY 3285/7

For Specialised and Personal Service to the Trade & Industry

NATIONAL ELECTRICAL SUPPLIES CO. LTD.

Stockists and Distributors of

SQUARE □ ELECTRICAL CONTROL GEAR

and all leading Electrical Products

Write or 'phone for immediate Service:

NATIONAL HOUSE • 240-242 KING STREET • LONDON • W.6

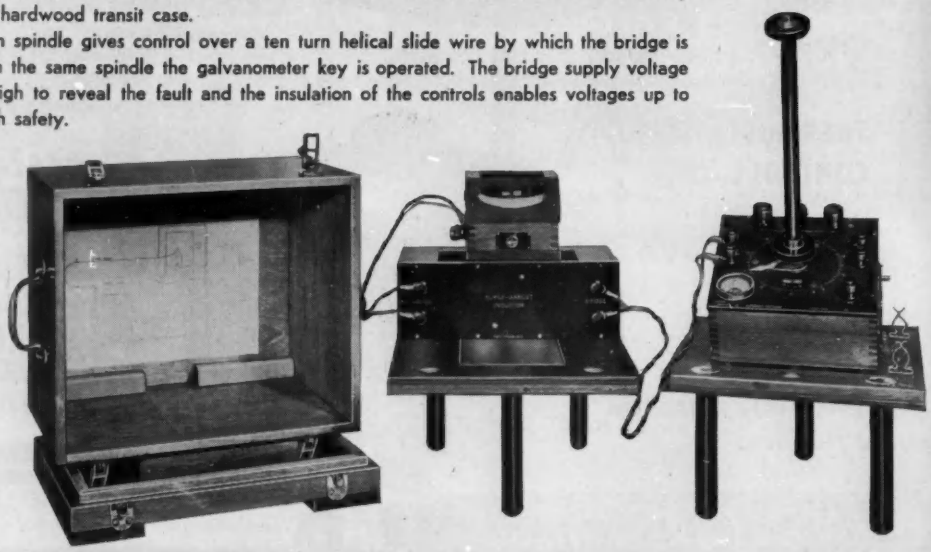
RIVerside 4655 (12 lines)

CABLE FAULT LOCATING SET (H.T.)

(FOR APPLYING THE MURRAY LOOP TEST AT VOLTAGES UP TO 33 kV)

THE apparatus consists of a fault locating bridge and pointer galvanometer protected from induced surge voltages by a choke. These are mounted on insulated stands which can be conveniently stowed in a polished hardwood transit case.

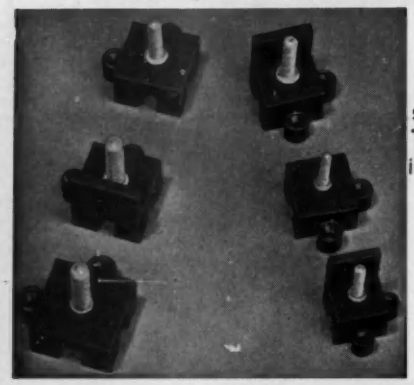
An insulated extension spindle gives control over a ten turn helical slide wire by which the bridge is balanced, and through the same spindle the galvanometer key is operated. The bridge supply voltage must be sufficiently high to reveal the fault and the insulation of the controls enables voltages up to 33 kV to be used with safety.



Telephone:
CROYDON 8282

GAMBRELL BROS. & CO. LTD. 105/107 Lansdowne Road, Croydon, Surrey

No longer NEW but accepted.



Unit construction TER-MATE inter-locking terminal blocks

Patented

Repeating orders and C S A Approval confirm the adaptability of these terminals which are now available in stud sizes ranging from 4. B. A. to 5/16" moulded in bases 5/8" square to 1 1/4" with or without barriers.

Any shape, any number of ways, anywhere, all as an integral unit, ideal for panels etc.

Samples and literature on request:—

TERMINATION EQUIPMENT CO. LTD.
MOSS WORKS, ELSON STREET, BASFORD, NOTTINGHAM
Tel.: Nottm. 76638/9

ELECTRICAL CONTRACTORS

LOW VOLTAGE INSTALLATIONS

We are now supplying installation materials for our well-known Low Voltage Overhead Grid System for Portable Inspection Lamps for your own erection. If desired, we are still glad to sub-contract for Low Voltage side of installation. Send for descriptive Brochure and price-list of our Rod Lamp Assemblies, Inspection Lamps only and special **Rough Service Low Voltage Bulbs**, whether for Overhead Grid system or for use with wall plugs—Quotations for Grid materials and Transformers to requirements.

Avoid trouble by refusing inferior copies of our Lamps or System.

KELVIN NORTON ELECTRIC CO. LTD.
25 BARBAULD STREET, WARRINGTON
LANCASHIRE. TEL.: WARRINGTON 31925

If you need

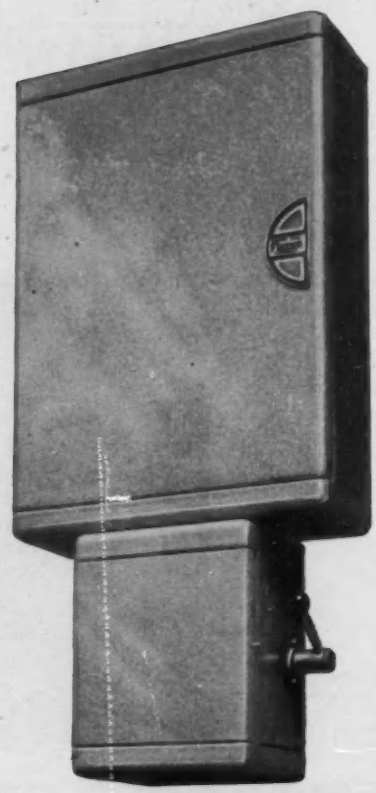
a small **METAL PRESSING** for your product, why not consult us?

We specialise in light precision presswork in all metals for the Electrical Trades.

QUOTATIONS BY RETURN

BIRMINGHAM SPECIALITIES LTD.
80-81 Bath Street, Birmingham 4. *Phone: Central 2492*

AEROFLEX
Fluvent



CABINET STYLE DISTRIBUTION BOARDS WITH ISOLATING SWITCHES

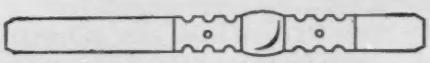
Widespread acceptance of Fluvent Cabinet Style Boards has resulted in production of a Switch of similar exterior. Intended principally for use as control switches mounted in conjunction with the boards, 30 and 60 amp. sizes are available with S.P. and neutral link as an alternative to D.P. (in the same dimensions as D.P.), and T.P. with neutral link (in the same dimensions as T.P.).

UNOBTRUSIVELY EFFICIENT

Both boards and switches have pressed steel cabinets which are cadmium plated and painted to give a grey metallic hammer finish. All edges are rounded to a uniform radius, the lid is sunk flush and the hinges invisible. Maximum accessibility is ensured by the door swing which is almost 180°.

WITH Aeroflex ENERGY LIMITING FUSES

Cabinet Style Distribution Boards are fitted with Aeroflex Energy Limiting High Breaking Capacity Cartridge Fuse Links to British Standard No. 88, 1952, 46 K.A. Breaking Capacity on 440 volts, with 1.25 fusing factor. Standard fully wired cartridge fuse links are included unless otherwise specified, when appropriate underwirings can be fitted. Fuse links are not discarded when blown — they can be returned for prompt replacement under our rewiring service scheme.



✻ *The latest type of Aeroflex fuse element as employed in the AD and FC type Energy Limiting Fuses.*

Parmiter Hope & Sugden Ltd

FLUVENT ELECTRICAL WORKS MANCHESTER 12

London: 34 Victoria Street, S.W.1. *Glasgow:* 5 Somerset Place, C.3 *Birmingham:* 39/41 Carrs Lane, 4

H

dm PH137

MOTOR PROTECTION THERMAL RELAY

TYPE H, HST, HST/AM

The essential feature found in these protective devices is that they remain inoperative on starting surges yet protect induction motors against prolonged overloads—of vital importance where maintenance of continuous service is necessary. Full details of these relays are available on request.

APPLICATIONS

Type H relays are designed to protect three-phase star or delta-connected induction motors against overload or single-phasing conditions, where the starting current does not exceed 7 times normal.

Type HST relays offer similar protection to larger motors having starting currents in excess of 7 times full load and which are likely to be prolonged because of high inertia loads.

Type HST/AM relays offer additional instantaneous protection against short-circuit faults.

For full details please send for Cat. Section 7700

Solar Works, Birmingham 5
London Office:
Magnet House, Kingsway, W.C.2
Telephone:
TEMple Bar 8000

CHAMBERLAIN AND HOOKHAM LTD.

Classified Advertisements

CLASSIFIED advertisements are PREPAID at 3/6 per line (approx. 6 words) per insertion. Where an advertisement includes a Box Number there is an additional charge of 1/-.

DISPLAYED CLASSIFIED:—48/- per inch. Cheques and Postal Orders should be crossed and made payable to ELECTRICAL REVIEW PUBLICATIONS LTD.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

REPLIES to Box Numbers should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1, but if not to be delivered to any particular firm or individual they should be accompanied by instructions to this effect, addressed to the Manager of the ELECTRICAL REVIEW. Replies in such cases cannot be returned. The name of an advertiser using a Box Number will not be disclosed.

ADVERTISEMENTS are accepted up to **First Post on Monday** of the week of issue and should be addressed to ELECTRICAL REVIEW, Classified Advertisement Department, Dorset House, Stamford Street, London, S.E.1.

Original testimonials should not be sent with applications for employment

OFFICIAL NOTICES, TENDERS, ETC.

CITY OF BELFAST

Electricity Department

TENDERS are invited for the supply, delivery and erection of :—

33/6.6 kV, 12,500-kVA
STEP-DOWN TRANSFORMERS.

Form of tender and specification (No. W.133), in duplicate, may be obtained at the Electricity Department, East Bridge Street, Belfast, on payment of a deposit of two guineas, which amount will be refunded provided a bona fide tender is lodged and not withdrawn. Extra copies of the contract documents may be obtained at one guinea each, which sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Each tender (original only), in sealed envelope marked "Tender for 33/6.6-kV, 12,500-kVA Step-down Transformers, Electricity Committee" and endorsed with the name and address of the tenderer, must reach the undersigned not later than 4 p.m. on Friday, 2nd May, 1958.

An official receipt must be obtained for each tender delivered by hand. Tenders sent by post should be registered.

The lowest or any tender will not necessarily be accepted.

JOHN DUNLOP,
Town Clerk.
P.O. Box 234,
City Hall, Belfast.
March, 1958. 3040

EPSOM AND EWELL CORPORATION

Water Department

Contract No. 5 :
Tenders for Wiring Installation

THE Council invite tenders for the supply and installation of "Pyrotenax" Mineral Insulated Copper Covered Cable for connection between Switchboards, Motors and Alternator at their East Street Works of the Water Undertaking.

Copies of the specification may be obtained on application to Mr. L. D. Evans, B.Sc.(Lond.), A.M.I.C.E., A.M.I.W.E., Borough Water Engineer and Manager, East Street, Epsom, on payment of a deposit of £1 1s., returnable on receipt of a bona fide tender not subsequently withdrawn.

Sealed tenders must be forwarded as directed so as to reach me by first post on Saturday, the 19th April, 1958.

The Council do not bind themselves to accept the lowest or any tender.

EDWARD MOORE,
Town Clerk.
Town Hall,
The Parade, Epsom. 3039

CITY AND COUNTY OF BRISTOL

TENDERS invited for supply of undermentioned lamps and electrical equipment during 12 months 1st July, 1958, to 30th June, 1959 :—

Tungsten Filament Electric Lamps.
Electric Discharge Lamps.
Mercury Tubular Fluorescent Lamps.
Transformers, 60 and 140 watt.
Capacitors.

Forms of tender, specifications and conditions of contract from City Engineer, 470, Bath Road, Bristol, 4. Tenders to be submitted by 3rd May, 1958. 2987

BOROUGH OF TODMORDEN

Rewiring of the Town Hall

TENDERS are invited for the rewiring of the Town Hall, Todmorden, and supply and fixing of certain lighting fittings.

Specification and form of tender obtainable from the Borough Engineer, Todmorden, on payment of a deposit of £2, repayable on receipt of a bona fide tender.

Tenders in plain sealed envelopes endorsed "Tender for Town Hall Rewiring" to be delivered to the undersigned not later than noon on Friday, 18th April, 1958.

The Corporation do not bind themselves to accept the lowest or any tender.

J. D. MOYS,
Town Clerk.
Municipal Offices,
Todmorden. 3022

BOROUGH OF MORLEY

Street Lighting Department

TENDERS are invited for the supply, erection and installation of 106 totally enclosed, non-cut-off type, 140-watt Sodium Lighting units mounted on 25' concrete columns.

Specification and forms of tender may be obtained from the Public Lighting Engineer, Town Hall, Morley, on payment of a deposit of £2 2s. The deposit will be refunded on receipt of a bona fide tender.

Completed tenders should be received by the Public Lighting Engineer not later than 9 a.m., Monday, 12th May, 1958.

E. V. FINNIGAN,
Town Clerk.
Town Hall,
Morley. 2985

BOROUGH OF NEWARK-ON-TRENT

Market Place Lighting

TENDERS invited for supply, erection and putting into service of a system of 16 fluorescent units on "Revo" columns, in enclosed lanterns. Conditions of contract and specifications may be obtained from and drawings inspected at the Borough Surveyor's Office, Municipal Buildings, Balderton Gate, Newark.

Tenders in plain sealed envelopes to Borough Surveyor by 30th April.

The Corporation does not bind itself to accept the lowest or any tender.

J. H. M. GREAVES,
Town Clerk.
Municipal Buildings,
Newark-on-Trent.
28th March, 1958. 3038

METROPOLITAN BOROUGH OF WANDSWORTH

Street Lighting Equipment

TENDERS invited for supply and erection of concrete lamp columns and ancillary gear for two schemes of sodium discharge street lighting.

The first (scheme K3) consists of 88 20-ft. and 707 15-ft. and the second (scheme K4) consists of 90 20-ft. and 741 15-ft. mounting height columns.

Tender documents, obtainable from Borough Engineer, must reach me by 10 a.m. 23rd April, 1958.

R. H. JERMAN,
Town Clerk.
Municipal Buildings.
Wandsworth, London, S.W.18. 3045

CLASSIFIED ADVERTISEMENTS ARE PREPAID

HOLYWELL URBAN DISTRICT COUNCIL

Street Lighting, Town Centre

TENDERS are invited for the supply, erection and putting into service of :—

1. 3 No. 25-ft. steel columns, brackets, lanterns and 250-watt MBF/U lamps.
2. 3 No. Wall brackets, lanterns and 250-watt MBF/U lamps.
3. 4 No. Remove existing brackets and lanterns from columns and replace with new brackets, lanterns and 250-watt MBF/U lamps.
4. 3 No. Resite existing 25-ft. steel columns and modify as 3 above.
5. 1 No. Remove existing wall bracket and lantern.

Plans and conditions of contract may be inspected at the office of the undersigned, from whom specifications and form of tender may be obtained on payment of a deposit of two guineas, which will be refunded on receipt of a bona fide tender, not subsequently withdrawn.

Sealed tenders, in the envelope provided, must be delivered to the Clerk of the Council not later than 25th April, 1958.

The Council do not bind themselves to accept the lowest or any tender.

F. E. G. GRAY,
Engineer and Surveyor.
Town Hall,
Holywell, Flints. 3008

SITUATIONS VACANT

ENGLISH ELECTRIC

Control and Electronics Division

have vacancies on Service Contract work for :—

1. ELECTRONIC ENGINEER with experience in circuit development. Post involves high personal responsibility and offers excellent prospects. Applicants should be Corporate Members of I.E.E. or equivalent.
2. ELECTRONIC ENGINEER with experience in engineering development. Good opportunities exist for advancement after introductory period. Applicants should be H.N.C. standard or equivalent.

An attractive staff pension scheme is available and housing assistance can be offered to suitable candidates.

Applications giving full details of qualifications and experience should be made to Dept. C.P.S., 336/7, Strand, London, W.C.2, quoting Ref. ER306G.

2989

CONTROL GEAR SALES ENGINEER

required for North-West. Knowledge of associated equipment and outside sales experience essential. Pension fund.

Applications, marked "Confidential," and stating experience, qualffications, age and salary required, to :—

Area Sales Manager
BRITISH KLOCKNER SWITCHGEAR LTD.
Cromford House, Cromford Court
Manchester, 4

3052

Situations Vacant (continued)

YORKSHIRE ELECTRICITY BOARD

No. 7 (Grimsby) Sub-Area

THIRD ASSISTANT ENGINEER (Distribution Design). Applicants should possess at least the Higher National Certificate in Electrical Engineering and should be preferably Graduate Members of the Institution of Electrical Engineers. They should have experience in the design, construction, operation and maintenance of H.V. and L.V. underground and overhead distribution systems, substation plant and ancillary equipment.

Salary N.J.B. Class J, Grade 10, £885/£15/£930 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Road, Grimsby, not later than 18th April, 1958.

No. 5 (Wakefield) Sub-Area

FOURTH ASSISTANT ENGINEER (Distribution Design). Applicants must hold at least the Higher National Certificate in Electrical Engineering, and should have had some experience in the construction, operation and maintenance of distribution networks and in the planning of H.V. and L.V. overhead and underground distribution systems, and the design of substations. Experience in the preparation of reports, load estimates and capital budgets is desirable.

Salary N.J.B. Class L, Grade 13, £835/£15/£880 per annum.

Applications, stating the above vacancy number, and giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a, Denby Dale Road, Wakefield, not later than 18th April, 1958.

No. 4 (Leeds) Sub-Area

WETHERBY DISTRICT

THIRD ASSISTANT DISTRICT ENGINEER, GARFORTH. Applicants should possess a good general and technical education and training and have had experience in the construction, operation and maintenance of E.H.T. and L.T. overhead and underground distribution systems in a mixed urban and rural district.

The successful applicant will be required to reside in the locality.

Salary N.J.B. Class F, Grade 9, £790/£15/£835 per annum.

Applications, stating the above vacancy number, and giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 4 (Leeds) Sub-Area, Yorkshire Electricity Board, Bramhope, near Leeds, not later than 18th April, 1958.

No. 6 (Hull) Sub-Area

DEMONSTRATOR. Candidates should have had domestic science training, including electrical housecraft, and should preferably hold the E.A.W. Certificate or Diploma. They should be competent to lecture and advise consumers on the utilisation of domestic electrical appliances and be able to give demonstrations with sales emphasis. The successful candidate will normally be located in Hull, but may be required to work throughout the Sub-Area if occasion demands.

Salary N.J.C. Grade 1, £500/£600 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 6 (Hull) Sub-Area, Ferensway, Hull, not later than 18th April, 1958.

3043

HASTINGS AND ST. LEONARDS TECHNICAL COLLEGE

ASSISTANT GRADE A (male) required for Engineering Department to teach general electrical and mechanical subjects to Final City and Guilds. Ability to help with O.N.C. Electrical Engineering an advantage.

Application forms and further particulars obtainable from Chief Education Officer, 20, Wellington Square, Hastings, should be returned within 21 days of the appearance of this advertisement. 3044

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

APPLICATIONS are invited for the following appointments in this Division :—

GENERAL ASSISTANT ENGINEER, AVON POWER STATION, WARWICK (Vacancy No. 38/58.ER).

A General Assistant Engineer is required at Avon Power Station, Warwick, where the suitable applicant will be given the opportunity to obtain operating and maintenance experience at this power station.

Applicants should be in possession of suitable engineering qualifications.

Salary will be within the range £540-£635 per annum, in accordance with the National Joint Board Agreement.

Closing date for receipt of applications, 16th April, 1958.

SECOND ASSISTANT ENGINEER (Electrical), GENERATION (Construction) DEPT., SPONDON "H" POWER STATION SITE (Vacancy No. 44/58.ER).

Preference will be given to applicants who hold a degree in electrical engineering, are Corporate Members of the Institution of Electrical Engineers, or possess other equivalent qualifications.

They should have had experience in the design and installation of switchgear, transformers and cables up to 33 kV, and other electrical equipment associated with modern power stations.

Experience in the preparation of specifications and estimates and preparing reports on tenders will be a recommendation.

Salary will be within Class AX/EX, Grade 4 (£1,145-£1,410 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 16th April, 1958.

OPERATION AND EFFICIENCY ENGINEER, CASTLE DONINGTON POWER STATION (Vacancy No. 57/58.ER).

Candidates should have wide experience of the operation and maintenance of a large modern power station with P.F. boiler plant. The successful applicant will be responsible to the Station Superintendent for ensuring that all sections of the plant attain the specified efficiency and for the carrying out of special investigations and tests.

The possession of the Higher National Certificate or equivalent would be an advantage.

Salary will be in accordance with Class L, Grade 6 (£1,325-£1,415 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 16th April, 1958.

These appointments will be pensionable under the terms of the (Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Divisional Establishments Officer, Central Electricity Generating Board, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. PLEASE QUOTE VACANCY NUMBER.

L. F. JEFFREY,
Divisional Controller.

31st March, 1958. 3010

UNIVERSITY OF DURHAM

King's College, Newcastle upon Tyne

THE Council of King's College invite applications for a LECTURESHIP IN ELECTRICAL ENGINEERING.

The salary scale rises by annual increments of £50 to a maximum of £1,650, and the commencing salary will be fixed at a suitable point on the scale in accordance with the qualifications and experience of the successful applicant. Family allowance and F.S.S.U. benefits.

Twelve copies of application, together with the names of three persons to whom reference may be made, should be submitted not later than 28th April to the undersigned, from whom further particulars may be obtained.

G. R. HANSON,
Registrar of King's College.

2991

YORKSHIRE ELECTRICITY BOARD

Head Office

CHIEF ENGINEER'S DEPARTMENT

THIRD ASSISTANT ENGINEER, DISTRIBUTION DESIGN (Substations).

The successful applicant will be required to assist with the design of indoor and outdoor substations operating at voltages of 33 kV and above, the preparation of specifications for substation plant, negotiations with plant manufacturers, and inspection of equipment in course of manufacture.

The minimum technical qualifications are the possession of a good Higher National Certificate in Electrical Engineering and Graduate Membership of the Institution of Electrical Engineers.

Applicants should have had a few years' general experience of field construction work and should preferably have some practical knowledge of the construction and erection of substation plant.

The work offers scope for the development of technical knowledge and experience, particularly in respect of switchgear, transformers and protective gear.

Salary N.J.B. Schedule B, Grade AX-EX 6, £895/£25 to £1,020/£1,140 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Secretary, Yorkshire Electricity Board, Wetherby Road, Scarcroft, Near Leeds, not later than 23rd April, 1958.

No. 2 (Huddersfield) Sub-Area

HALIFAX DISTRICT

THIRD ASSISTANT DISTRICT ENGINEER.

Applicants should be Graduate Members of the Institution of Electrical Engineers or hold equivalent qualifications and have had experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Salary N.J.B. Class H, Grade 9, £885/£15/£930 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 2 (Huddersfield) Sub-Area, Yorkshire Electricity Board, Market Street, Huddersfield, not later than 23rd April, 1958.

No. 5 (Wakefield) Sub-Area

DONCASTER DISTRICT

THIRD ASSISTANT DISTRICT ENGINEER (2 posts).

Applicants should have had practical training and experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Candidates should preferably have attained the technical standard of the Higher National Certificate in Electrical Engineering or equivalent qualifications.

Candidates must be prepared to reside in the district and undertake standby duties.

Salary N.J.B. Class F, Grade 9, £790/£15/£835 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a, Denby Dale Road, Wakefield, not later than 23rd April, 1958. 3063

BRITISH STANDARDS INSTITUTION

Technical Staff

THE B.S.I. invites applications from engineers to join the technical staff of the Institution. The technical staff are responsible for the work of the Institution in the preparation of British Standards in co-operation with the various sections of industry and are required to plan and progress the work.

Applicants should have a university degree or equivalent professional qualification in civil, electrical or mechanical engineering.

There are three grades of appointment, with an over all salary range up to £2,000; applications are invited for the grade which has at present a maximum salary of £1,250, the starting figure being dependent on individual qualifications and experience. The posts are pensionable.

Apply to the Establishment Officer, B.S.I., 2, Park Street, London, W.1. 2992

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

Construction Engineer

APPLICATIONS are invited for the post of CONSTRUCTION ENGINEER in the Generation Department for work of a temporary nature at the Commission's Power Station in Penal. The Construction Engineer will be employed mainly in connection with the second 20-MW extension to the power station and will be responsible for the administration and organisation of the site. He will also be responsible to the Technical Assistant (Civil Engineering) for the direct supervision of all works of a building and civil engineering nature, including the laying of large water mains.

Applicants should have had experience as a general foreman of civil engineering construction sites personally supervising reinforced concrete construction, steelwork erection and general building work. Experience in the laying of large water mains and road-making would also be an advantage.

A period of service as a Clerk of Works or similar post in a Municipal Surveyor's Department would also be an advantage.

The appointment is for one contract of approximately three years at a salary commencing at £1,580 per annum. Leave is granted at the rate of 45 days per year and a free first class passage will be provided to and from Trinidad for the successful candidate, his wife and for children up to the value of two adult fares. A partly furnished house at Penal will be provided at a rental of £10 8s. 4d. per month plus approximately £2 10s. for heavy furniture. An outfit allowance of £60 will be paid on arrival in Trinidad.

General information on Trinidad climate, income tax, etc., can be obtained from the West India Committee, 40, Norfolk Street, London, W.C.2. Further information of the Commission may be obtained from the address shown below.

Applications giving full details of experience should reach the General Manager, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad, B.W.I., not later than 19th May, 1958. 2994

INSTRUMENT MECHANICS

required for the maintenance and repair of a wide range of Industrial Instruments in a large Chemical Works. Candidates should preferably have served a recognised apprenticeship, but this is not essential.

There is a merit rating scheme in operation in the company which ensures that good tradesmen receive a high rate of pay. Canteen and excellent recreation facilities are available.

Applications in writing, giving full history, should be sent to :—

Labour & Welfare Officer (Oldbury)
ALBRIGHT & WILSON (MFG.) LTD.
P.O. Box No. 3, Oldbury

3035

CENTRAL ELECTRICITY GENERATING BOARD

Press Officer

PRESS OFFICER required to take charge of the Press Section of the Public Relations Branch at Board Headquarters, London, W.1. An experienced journalist with some knowledge of press liaison work, and preferably of electricity industry, is required. Salary within scale £1,335–£1,455 p.a. according to qualifications and experience.

Letters of application stating age, qualifications, experience, present position and salary should be forwarded to S. S. Scott, Chief Personnel Officer, 24/30, Holborn, London, E.C.1, by 21st April. Envelopes should be marked "Confidential," quoting reference ER/99. 3009

CENTRAL ELECTRICITY GENERATING BOARD

London Division

APPLICATIONS invited for following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A. Salary includes London allowance. Qualifications entitling to Graduate Membership of I.E.E. or I.Mech.E. an advantage.

ASSISTANT ENGINEER (Electrical),
BRUNSWICK WHARF
POWER STATION
(Vacancy No. 58/238).

Applicants will be on electrical maintenance staff to assist with testing of station electrical plant and protective gear. Duties involve primary and secondary injection of current transformers and relays; pressure testing of H.V. cables, motors and switchgear; fault investigation, including electronics equipment, and with the commissioning of new plant. Salary Class K, Grade 12 = £885 p.a.

STATION SHIFT CONTROL ENGINEER,
HACKNEY POWER STATION
(Vacancy No. 58/239).

Sound engineering training with some experience in control and operation of steam generating plant and main switchgear in modern power station. Salary Class H, Grade 10 = £885 plus £83 10s. shift p.a.

FIRST ASSISTANT STATION CHEMIST,
TAYLORS LANE POWER STATION
(Vacancy No. 58/240).

Applicants should be suitably qualified, have had experience in a power station laboratory, and be fully conversant with the testing and analysis of fuels, oils and water. Salary Class F, Grade 9 = £830 p.a.

Applications, quoting vacancy number, to (or on form from) Central Electricity Generating Board, London Division, P.O. Box 136, London, W.1, by 21st April, 1958. 3048

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division
Vacancy No. 36/ER/58

APPLICATIONS invited for superannuable N.J.B. appointments in the Drawing Office, Generation (Construction) Department, Divisional Headquarters.

SENIOR DRAUGHTSMAN (Electrical).
SENIOR DRAUGHTSMAN (Mechanical).

Salary Schedule D, Grade 4, £895 × £20 to £995, or Schedule D, Grade 5, £760 × £20 to £860.

ENGINEERING DRAUGHTSMAN (Electrical).
ENGINEERING DRAUGHTSMAN (Mechanical).

Salary Schedule D, Grade 6, £595 × £20 to £715.

Candidates should be suitably trained, possess an Ordinary or Higher National Certificate, and be experienced in one or more classes of plant installed in power or substations, such as :—

1. Boilers, conveyors, ash and coal handling, and station auxiliary plant.
2. Turbo-alternators, H.P. and L.P. steam and feed pipework, condensing and feed heating systems.
3. Switchgear, transformers, cables, overhead lines; knowledge of protective gear advantageous.

Application forms obtainable from Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Road, Gabalfa, Cardiff, to be returned by 16th April, 1958. 3011

SALES ENGINEER

APPLICATIONS are invited for an experienced SALES ENGINEER to cover the sales of industrial and commercial lighting equipment in the counties of Notts., Derbyshire and Lincolnshire.

Applicants must be resident in the Nottingham area, must be of good appearance and education, capable of negotiating with senior executives and electrical engineers in industry.

A good salary will be paid to the successful applicant and car provided. Opportunity will be given to join the superannuation scheme.

Write, in confidence, giving age, education and training, sales experience, etc., to the Area Manager, The Benjamin Electric Ltd., 5, Corporation Street, Birmingham, 2. 2990

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Division

APPLICATIONS are invited for two positions of SECOND ASSISTANT ENGINEER for day duties in the System Operation Department. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 4, £1,145 to £1,410 per annum.

The duties will include for :—

(a) investigations into and reporting on all types of system operation problems, the evaluation of extra costs incurred when generation and transformer plants are out of service, and supervision of the preparation of system operation statistics and analyses.

(b) the co-ordination of generation plant outages, forward load estimation, review of daily operating programmes, and investigation into special operating conditions.

Applicants should, for (a) have had sound technical training and operation experience in the electricity supply industry, and (b) have had considerable experience in power stations and in system control work. They should hold qualifications leading to Corporate Membership of the Institution of Electrical or Mechanical Engineers or equivalent.

Apply, quoting vacancy number 775 (a) or (b) MD, on form AE6, available from the Establishments Officer, 53, Wake Green Rd., Moseley, Birmingham, 13, by 24th April, 1958. 3049

SOUTH OF SCOTLAND ELECTRICITY BOARD

Lanarkshire Area

Second Assistant District Engineer, Uddingston District

APPLICATIONS are invited for the above appointment. Applicants should possess the necessary technical qualifications and should have had a sound engineering training, with subsequent experience in the operation and maintenance of H.V. and L.V. underground and overhead distribution systems and with H.V. fault location. They should also be conversant with load flow diagrams and voltage drop calculations.

The salary and conditions of service will be in accordance with the National Joint Board Agreement, Schedule A. The present classification and grading is F.7, salary £885/£930 per annum. The post is superannuable, subject to satisfactory evidence of health.

The successful candidate will require to reside within a reasonable distance of the District Offices at Uddingston, and to take part in standby duty in accordance with the above agreement.

Application forms, which may be obtained from the undersigned, should be forwarded to this office within 14 days of the date of this advertisement.

DUGALD SMITH,
Manager.
137, Almada Street,
Hamilton. 3041

JOSEPH LUCAS (ELECTRICAL) LTD.

ASSISTANT ELECTRICAL DESIGN ENGINEER

required for the design of rotating electrical equipment. Candidates should have Higher National Certificate, preferably some works training, and drawing office and design experience with small A.C. and D.C. machines. The position covers work on a wide range of machines, carries a good starting salary, and provides excellent prospects for advancement.

Five-day week. Staff pension fund.

Apply, in writing, giving details of age, qualifications and experience, to the Personnel Manager, Joseph Lucas (Electrical) Limited, Great King Street, Birmingham, 19, quoting reference PM/D/208.

127

Situations Vacant (continued)

SOUTH EASTERN ELECTRICITY BOARD

SHOWROOM SUPERVISOR, Crawley and Horsham District.

Annual salary £690 × £20 increments to £750 under N.J.C., Grade 3. Superannuable. Person chosen will be required to work in the showroom of Crawley New Town.

Applicants should have had experience in the day-to-day operation of a busy showroom, supervision of other showroom staff, planning window displays, co-ordination of sales activity programmes, control of stock, and should be able to advise consumers on all supply matters, including application of tariffs.

Applications, naming two referees, to L. J. Simmons, M.I.E.E., M.B.I.M., District Manager, SEEBOARD, 32/40, North Street, Horsham, by 23rd April, 1958.

FOURTH ASSISTANT ENGINEER, PLANNING AND DEVELOPMENT, Kent Area H.Q., Rochester.

Salary £835 × £15 to £880 per annum under N.J.B. Class L, Grade 13. Superannuable.

Candidates should preferably have the Higher National Certificate or equivalent, and practical experience in the operation, maintenance and construction of M.V. and 11-kV underground and overhead systems, together with a knowledge of network calculations.

Applications, naming two referees, to H. F. Knell, M.B.E., J.P., M.I.E.E., Kent Area Manager, SEEBOARD, 178, High Street, Rochester, Kent, by 23rd April, 1958.

ASSISTANT DISTRICT ENGINEER, Medway District.

Salary £835 × £15 to £880 under N.J.B., Class F, Grade 8. The post, which is superannuable, is in a District with a considerable amount of varied industry, in addition to domestic and commercial load.

Candidates should preferably hold the Higher National Certificate or equivalent, and practical experience in the operation, maintenance and construction of 11-kV and medium-voltage underground and overhead systems. Knowledge of the preparation of extension and reinforcement schemes will be an advantage.

Applications, naming two referees, to Ramsden Mellor, Esq., M.I.E.E., Medway District, SEEBOARD, Gardiner Street, Gillingham, Kent, by 23rd April, 1958.

G. WRAY,
Secretary. 3051

ENGLISH ELECTRIC

PROFESSIONAL engineering appointments are available with the Switchgear Organisation of this Group on a range of Application and Contract Engineering duties.

Experience in manufacture, power generation and supply or in the utilisation of electricity is sought and professional engineers are invited to apply for consideration.

A number of vacancies also exist for younger engineers with Higher National Certificate in Electrical Engineering and preferably having served an engineering apprenticeship, which offer opportunity for acquiring experience, scope for advancement and training as professional engineers.

All appointments are pensionable after a qualifying period.

Apply stating age, experience and qualifications to Dept. C.P.S., 336/7, Strand, London, W.C.2, quoting Ref. ER418F.

2988

LONDON COUNTY COUNCIL

South-East London Technical College, Lewisham Way, London, S.E.4

SEPTEMBER, 1958

GRADE B ASSISTANT for Electrical Engineering to H.N.C. standard. College offers full and part-time day and evening courses. Salary £650 × £25 to £1,025 plus London allowance, additions for training and qualifications.

Forms from Secretary to be returned by 25th April, 1958. (576) 3026

CENTRAL ELECTRICITY GENERATING BOARD

Eastern Division

APPLICATIONS are invited for the following posts:—

SHIFT CHARGE ENGINEER. LUTON GENERATING STATION.

Salary N.J.B. Class E, Grade 7, £835 × £15 to £880 per annum, plus 10% shift allowance.

Applicants should possess experience in the operation of steam generating stations. An apprenticeship and technical qualifications to Ordinary National Certificate standard in electrical or mechanical engineering will be advantageous.

FOURTH ASSISTANT ENGINEERS. SYSTEM OPERATION DEPT., THAMES NORTH GRID CONTROL AREA.

Salary N.J.B. Class AX/EX, Grade 8, £710 × £25 to £835/£935 p.a.

Applicants should have qualifications to Higher National Certificate standard and should be prepared ultimately to undertake shift duties in the area grid control room. Some steam generating station experience is desirable.

Apply by 26th April, 1958, quoting reference number 2/9130, giving age, details of qualifications and experience to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts.

W. N. C. CLINCH,
Controller.
3047

SOUTH OF SCOTLAND ELECTRICITY BOARD

Lanarkshire Area

(a) Demonstrator
(b) Trainee Demonstrator

APPLICATIONS are invited for the positions of DEMONSTRATOR and TRAINEE DEMONSTRATOR at Area Headquarters at Hamilton.

Applicants should possess a diploma or certificate in domestic science and should be able to advise consumers in the selection and use of electrical apparatus. The persons appointed will be required to give public demonstrations and assist in the sale of apparatus in service centres and in consumers' premises.

The conditions of employment will be in accordance with the National Joint Council Agreement and the salary will be :—

(a) Grade 1, £500/£600 per annum.
(b) General Clerical Scale.

The positions are superannuable.

Application forms, which may be obtained from the undersigned, should be forwarded to this office within 14 days of the date of this advertisement.

DUGALD SMITH,
137, Almada Street, Manager.
Hamilton. 3042

JOSEPH LUCAS

(ELECTRICAL) LIMITED

Great King Street, Birmingham, 19

ENGINEER

EXPANSION of development of ignition equipment for gas turbines and allied projects creates a vacancy for a practical engineer with experience of design for economic production of electrical apparatus. The work is of a high technical standard and applicants should preferably possess an honours degree.

The post is permanent and pensionable and offers considerable scope for advancement to a progressive engineer.

Apply in writing stating age, qualifications and experience to the Personnel Manager. Joseph Lucas (Electrical) Ltd., Great King Street, Birmingham, 19, quoting reference PM/D/190.

128

COLLEGE OF TECHNOLOGY, BIRMINGHAM

(Designated College of Advanced Technology)

DEPARTMENT OF ELECTRICAL ENGINEERING

APPLICATIONS are invited for the following posts :—

SENIOR LECTURER.
LECTURER.
ASSISTANT GRADE "B."

Salary :—
Senior Lecturers
(Men) £1,350 × £50 to £1,550.
Lecturers
(Men) £1,200 × £30 to £1,350.

In fixing the commencing salary, account may be taken of industrial, professional or research experience up to the maximum of the scale.

Assistant Grade "B"
(Men) £650 × £25 to £1,025

with additional graduate training allowances where applicable. In fixing the commencing salary, account will be taken of teaching and industrial experience.

Further particulars and forms of application from the Registrar, College of Technology, Suffolk Street, Birmingham, 1, on receipt of stamped addressed foolscap envelope. Applications to be received within 14 days of this advertisement.

K. R. PILLING,
Clerk to the Governing Body.
3012

CENTRAL ELECTRICITY GENERATING BOARD

Southern Division

APPLICATIONS are invited for the following positions :—

GENERAL ASSISTANT ENGINEERS (S/13.933)

Applicants should have served an apprenticeship or had practical training suitable to the industry. They should possess a sound general and technical education and preference will be given to those possessing a Higher National Certificate (or those nearing completion of H.N.C. courses). Opportunities are available for general assistant engineers to complete their studies and gain wide experience with good prospects of promotion.

The duties of those appointed will vary, but will include as a general rule the operation and control, under supervision, of generating plant. A number of these vacancies are at the oil-firing stations at Marchwood, near Southampton, and Poole.

Vacancies also exist for those who wish to specialise in maintenance of electrical and mechanical generating plant, transmission lines, substations and cables, or generating construction work.

Salary N.J.B. within scales £540–£730.

Special application forms, obtainable only from P. D. A. Oliver, Esq., Divisional Secretary, Central Electricity House, High St., Portsmouth, should be returned by 23rd April, 1958. 3036

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

THIRD ASSISTANT ENGINEER (Planning) required at the Board's No. 2 Sub-Area Headquarters, Sandiway House, Northwich, Cheshire. Salary within range £935/£995 per annum (N.J.B. K/10).

Applicants should have had experience in overhead and underground distribution work. Technical qualifications essential.

Appointment subject to medical examination. Pension scheme.

Application forms obtainable from the Manager at the above address. Closing date 22nd April, 1958. 3024

TRANSFORMERS (WATFORD) LIMITED

require

TRANSFORMER ENGINEER-DRAUGHTSMEN.

These appointments will command a really high salary for fully experienced applicants able to work quickly, accurately and individually from basic principles.

Apply Managing Director, Transformers (Watford) Ltd., Sandown Road, Watford, Herts. 3014

NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments :—

Area Board Headquarters

ASSISTANT DISTRIBUTION CONTROL ENGINEER (shift duties), Chief Engineer's Department, with location at Board's Sub-Control Centre at Aykleyheads, Durham City. The successful applicant will be given suitable training and will be required to assist in the centralised control and operation of high-voltage interconnected distribution networks operating at voltages up to 66 kV.

Applicants should preferably possess H.N.C. in Electrical Engineering or equivalent qualification, and be conversant with operation and maintenance of high-voltage distribution equipment. Knowledge of district work or protective gear operation an advantage.

Starting salary will be according to qualifications and experience and within the range of Schedule B, Grade 8, £781-£1,001 per annum, inclusive of 10% shift allowance. N.J.B. conditions of service.

Tees Sub-Area

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER, Bishop Auckland Commercial District. Salary Schedule A, Class E, Grade 5, £935-£995. N.J.B. conditions of service.

Applications stating age, qualifications and experience to be received by the Assistant Secretary (Establishments), North Eastern Electricity Board, G.P.O. Box No. 117, Carliol House, Newcastle upon Tyne, within ten days of the appearance of this advertisement. 2993

ROYAL NAVAL SCIENTIFIC SERVICE

PHYSICISTS, ELECTRONIC ENGINEERS and MATHEMATICIANS required for 25 Senior Scientific and Scientific Officer posts at establishments in London area, Baldock, Harwell, Haslemere, Poole, Greenock and Rosyth. Also MECHANICAL ENGINEER for work on heat transfer problems at Harwell. MECHANICAL ENGINEER for work on fuel and lubricating oil problems in London area. MECHANICAL ENGINEER for work on gas turbine problems in London area. CHEMICAL ENGINEERS for London area and Poole. METALLURGISTS for Rosyth and Poole. CHEMISTS (physical and inorganic) for Poole and Baldock.

Candidates must normally be natural-born British subjects of natural-born British parents, with at least First or Second Class Honours degrees or equivalent high professional attainments. S.S.O.s must have had at least three years' postgraduate experience and be 26 years of age.

Salaries (men): S.S.O. £1,190-£1,410; S.O. £635-£1,110 (London); somewhat lower in Provinces. Appointments are unestablished (with F.S.S.U. benefits), but opportunities may occur for those under 32 to compete for established posts.

Forms from M.L.N.S., Technical & Scientific Register (K), 26, King Street, London, S.W.1, quoting A.98/8A. 2807

ELECTRICITY AUTHORITY OF CYPRUS

APPLICATIONS are invited from candidates for appointment as either (a) STATION SUPERINTENDENT or (b) DEPUTY STATION SUPERINTENDENT with the Authority for two tours each of two years, with prospects of permanency, or in certain circumstances on temporary terms.

Salary (including bonus and overseas and temporary allowances) for post (a) £2,472 a year and for post (b) £1,852 rising to £2,104 a year. Outfit and settling-in allowances £35 £75 if accompanied by wife). Children's educational grants in certain circumstances. Free passages and furnished quarters. Liberal leave on full salary. Superannuation scheme similar to C.E.G.B. scheme. Benefits under latter scheme may sometimes be preserved.

Candidates must be Corporate Members of the Institutions of Mechanical or Electrical Engineers or equivalent. They should have had extensive experience of public electricity undertakings with particular respect to the operation and maintenance of steam-powered station plant and associate equipment, including 66-kV substations.

Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/42690/EF. 3005

PORT OF LONDON AUTHORITY

PORT OF LONDON AUTHORITY invite applications for the position of ASSISTANT ENGINEER (Electrical), Chief Engineer's Department, Head Office.

Salary scale £1,265 rising by annual increments to £1,715 per annum, with commencing rate according to age and experience.

Candidates, who must be British subjects and Corporate Members of the Institution of Electrical Engineers, should have served a recognised apprenticeship with one of the major electrical manufacturing firms and should have experience in the specification, installation, operation and maintenance of the electrical equipment of a dock or harbour undertaking or heavy industrial organisation, including H.V. and L.V. distribution systems, rectifying plant, A.C. and D.C. cranes and pumping plant, large lighting schemes and V.H.F. radio-telephony. Preference will be given to candidates not over 40 years of age.

The successful applicant will be required to become a member of the Port Authority's contributory superannuation scheme. In certain cases existing pensionable service is transferable.

Application forms may be obtained from the Establishment Officer, Port of London Authority, Trinity Square, London, E.C.3. 2940

CLERK OF WORKS (ELECTRICAL)

required by W.D. at Arborfield.

Applicants must be of British parentage and possess following qualifications. Ordinary National Certificate in Electrical and/or Mechanical Engineering or evidence of equivalent standard of technical education ; and five years' apprenticeship or equivalent with an engineering concern giving good comprehensive training. Completion of course at S.M.E. required for appointment to Establishment for Engineering Services as Clerk of Works (Electrical) constitutes equivalent qualification. In addition must have following experience : After completing apprenticeship at least three years with an engineering firm giving good comprehensive experience, or three years' service as supervisor of labour, chargehand or technical officer in the engineering industry.

Salary assessed according to age, qualifications and experience on provincial range of £655 (at age 26) to £820 per annum. Post is temporary but with long-term possibilities.

Application to C.R.E., North Aldershot, Redvers Buller Road, Marlborough Lines, Aldershot. 3025

INSPECTOR OF WORKS

(Water Supply)

required by the UGANDA GOVERNMENT PUBLIC WORKS DEPARTMENT on contract for one tour of 30/36 months in first instance, with provident fund benefits or gratuity at rate of 13½% of total substantive salary drawn.

Salary according to experience in scale (including inducement pay) £813 rising to £1,341 a year. Outfit allowance £30. Free passages. Liberal leave on full salary.

Candidates must have served a full electrical apprenticeship. They should have had at least five years' responsible experience as an industrial maintenance electrician and should have some knowledge of the operation of multi-stage centrifugal pumps.

Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/42695/EF. 3006

ELECTRICAL DESIGN ENGINEER

required for work on chemical plants.

Experience of heavy duty electrical equipment essential. Must be able to originate and carry through full electrical schemes. A knowledge of electrical instrumentation an advantage.

Progressive position for the right person. Comprehensive superannuation scheme.

Reply to Technical Manager, Air Products (Great Britain) Ltd., 9, Upper Belgrave Street, London, S.W.1. 3059

CENTRAL ELECTRICITY GENERATING BOARD

South Western Division

FOURTH ASSISTANT ENGINEER required in the System Operation Department, Divisional Headquarters, nr. Bristol.

Superannuation scheme. Salary N.J.B. Class AX/EX, Grade 8, £710-£835/£935.

Applicants should have had a good general and technical education to Higher National Certificate standard, with an aptitude for mathematics. Steam generating station experience is desirable.

Duties include general statistical work, particularly costing.

Some day/evening shift duties in the control room may be required, for which the 10% shift allowance would be paid.

Applications on form A.E.6/ACT, obtainable from the Divisional Secretary, 26, Oakfield Rd., Bristol, 8, should be completed and returned by 19th April, 1958. 3023

AIR MINISTRY

WORKS Design Branch requires in London and Provinces ELECTRICAL ENGINEERING DRAUGHTSMEN experienced in preparation of schemes for illumination and electrical equipment of buildings or in electrical distribution, H.V. and M.V. Technical training to O.N.C. standard or equivalent an advantage.

Salaries in LONDON up to £1,015 per annum. Somewhat lower in PROVINCES. Starting pay dependent on age, qualifications and experience. Long-term possibilities with pensionable and promotion prospects. 5-day week, 3 weeks 3 days leave a year.

Liability for overseas service. Normally natural-born British subjects.

Write stating age, qualifications, employment details, including type of work done, to any Employment Exchange, quoting Order No. Borough 104. 257

ELECTRICAL ENGINEER

THE MARINE DEPARTMENT of ENGLISH ELECTRIC, RUGBY, have a vacancy for an

ELECTRICAL ENGINEER

with a good knowledge of medium range electrical machines and switchgear. Applicants should be between 26 and 30, preferably single, and be capable of preparing electrical layouts for marine applications.

Write giving full details to Dept. C.P.S., 336/7, Strand, London, W.C.2, quoting Ref. ER1118.B.

3027

EASTERN ELECTRICITY BOARD

Essex Sub-Area (34/58.R)

SOUTHEND DISTRICT: FOURTH ASSISTANT ENGINEER. Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems, including substations.

Salary N.J.B. Class G, Grade 11 (£740-£785 per annum).

The successful candidate will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Apply by letter, within 14 days, to J. Linton, M.I.E.E., A.I.Mech.E., District Manager, Eastern Electricity Board, 85, London Road, Southend-on-Sea, Essex. 3037

ELECTRONICS ENGINEERS

for GUIDED MISSILE work for the NAVY in Admiralty Establishments. Recognised apprenticeship or equivalent training required together with University Degree, A.M.I.E.E. or exempting qualifications. Age not less than 25.

Salary range £780 at 25 to £1,215. Starting salary according to age up to £1,055 at 34.

Application forms, quoting ref. D118/8A, from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1. 3064

***Situations Vacant** (continued)*

WORKSHOP INSTRUCTOR
(Electrical Installation)

required by the GOVERNMENT OF CYPRUS Education Department for one or two tours of 21 months either (i) on agreement with prospect of permanent and pensionable employment or (ii) on contract with gratuity at rate of £100 a year. Salary scale (including overseas allowance and present temporary allowance of 21½% of salary) £1,017 rising to £1,400 a year. Outfit allowance £30. Free passages. Education grant payable in certain circumstances. Liberal leave.

Candidates must have served an apprenticeship to electrical engineering, have had subsequent experience and possess a C. and G. Full Technological Certificate in electrical installation work and preferably in electrical engineering practice.

Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/42421/EF. 3046

SOUTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the position of SURVEYOR in the Western Sub-Area of the Board, based at Tenby.

Salary Schedule D, Grade 6 (£595/£715) ot the N.J.B. Agreement.

Applications, stating age, present position and salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 21st April, 1958. 3050

ALUMINIUM LABORATORIES Limited, research and development organization of the Aluminium Limited Group, have a vacancy for an electrical engineer to develop and test the application of aluminium and its alloys in prototype electrical equipment (emphasis on insulated cables, overhead line conductors and transformers). Applicants should possess H.N.C. or Corporate Membership of I.E.E. The post carries a large measure of responsibility and requires initiative and organizing ability. Pension and life assurance scheme in operation. Apply to Personnel Officer, Aluminium Laboratories Limited, Banbury, Oxon. 2965

ARMATURE winder for A.C. and D.C. work. Must be first-class man, preferably with repair shop experience.—The Midland Electric Installation Co. Ltd., Upper Villiers Street, Wolverhampton. 2999

ARMATURE winder. Progressive firm have vacancy for skilled man having sound knowledge all types A.C. and D.C. work.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. (Edgware 5566). 3054

ARMATURE winders: Working foreman and winder required. Sound knowledge A.C. and D.C. work. Uxbridge area.—Box 3015

CONSULTING engineers require young engineers in London office for nuclear projects. Electrical or mechanical degree preferable, experience in power station work desirable. Nuclear training provided if necessary. Write Kennedy & Donkin (HJP/2), 12, Caxton Street, London, S.W.1. 3055

CONTROL gear engineer required, age 23-35, for layout and circuiting of contactor equipment. Good salary. Permanent and progressive position. Canteen, pension scheme. Write stating age, experience and qualifications, if any, to Personnel Officer, Dewhurst & Partner Ltd., Inverness Road, Hounslow, Middlesex. 273

CROMPTON PARKINSON Limited require a service engineer for their stud welding organisation in the London area. The position carries sales responsibilities and applicants should be capable of co-operating with customers at all levels. Experience of electro/mechanical servicing combined with some welding knowledge would be an advantage. Full training will be given. Excellent working conditions, 5-day week, superannuation scheme. Applications to—Ref. USer, 1/3, Brixton Rd., London, S.W.9. 3053

DESIGN engineer required for electrical automatic and hand control gear. Must have knowledge of electronics. Progressive position; substantial salary; pension scheme. Full details to—Box 3000.

DESIGNER-draughtsman for small electrical accessories, preferably with experience and qualifications. Pension scheme. Apply with full particulars to—Wandsworth Electrical Mfg. Co. Ltd., Albert Drive, Woking, Surrey. 3056

DESIGNER-draughtsman, senior, electrical, required. Experience is preferred in the application of diesel-driven generating machinery up to 200 kW and its associated control gear, including portable, standby, automatic mains failure equipment, etc. Experience essential in control gear and circuit layout. Good salary offered. Pension scheme. Canteen facilities. Reply for the attention of the Chief Engineer, Henry Meadows Ltd., Fallings Park, Wolverhampton. 3057

DEWHURST & PARTNER Ltd., of Suffolk House, Suffolk Street, Birmingham, require the services of an area manager. Successful applicant must have a wide technical and commercial knowledge of motor control gear applications and a proven record of technical selling ability. Senior appointment. Car provided. Apply in first instance to the Regional Manager, at the above address, stating age, qualifications, selling experience and approximate salary required. 2897

DEWHURST & PARTNER Ltd. require technical estimator for preparing tenders in their estimating engineering department. Applicant must have good electrical engineering background and have basic knowledge of motor control equipment and its applications. The position is a senior one, and housing assistance will be given to successful applicant if necessary. Canteen facilities, pension scheme. Write giving age, experience, etc., to — Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middlesex. 274

DRAUGHTSMAN for office in Bayswater. Work mostly on electrical installations and layout for retail shops. Five-day week. Canteen. Salary according to age and experience. Apply to — Chief Engineer's Dept., United Dairies Ltd., Cumberland Avenue, Park Royal, London. N.W.10. 2896

DRAUGHTSMAN required by progressive firm for interesting work mainly in connection with electrical rotating machines and associated equipment. The position offers good prospects and a non-contributory life assurance and pension scheme is in operation. Apply giving full details of experience to — Arthur Lyon & Co. (Engineers) Ltd., Park Works, Stamford, Lincs. 2898

ELECTRICAL engineer required by West Midlands firm for work in development laboratory on discharge lamp circuits and control gear. H.N.C. or equivalent qualification desirable.—Box 3029.

ELECTRICAL engineers, junior and senior, required for consulting engineers' office in London. Salary £600-£900 depending upon age, qualifications and experience.—Box 160.

ELECTRICAL or mechanical engineer wanted by large German company for German-English translations. Applications are invited from British-trained engineers with a good knowledge of German who have an inclination towards translation work and desire to work in a pleasant environment in Germany for at least 2 to 3 years. Write stating age, education, experience and salary to—Box 3030.

ELECTRO-mechanical draughtsmen required for production drawing office of company engaged in the manufacture of control gear equipment. Good salaries paid to "first-class" men. Canteen facilities, pension scheme. Housing assistance considered in approved cases. Write giving age, experience, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middx. 275

ENGINEER required for technical sales and having good works and (preferably) office experience with regard to construction of new plant, overhaul, repair, redesign and rewinding of industrial electrical machinery. Experience in drawing up specifications of industrial installations an advantage. This is a senior post and has a considerable future. Please send full particulars (which will be treated in the strictest confidence) to the Managing Director, c/o Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford, Herts. 3058

JUNIOR development engineer required by Hoover Limited in their engineering department. Applicants should have Higher National Certificate (electrical) or equivalent, but man in final year would be considered. The successful candidate will be required to carry out experimental work on domestic appliances. Preference will be given to candidates who have had previous experience in this field. Apply, stating age, qualifications and experience, to the Employment Officer, Hoover Ltd., Perivale, Greenford, Middlesex. 3013

ENGINEER. E. K. Cole Ltd., Southend-on-Sea, have a vacancy in their Thermovent laboratories for an assistant engineer to assist in the design and development of tubular, convector and other types of heating apparatus. Minimum qualifications O.N.C. in electrical or mechanical engineering. Write stating age, qualifications and experience to Personnel Manager. 3031

EXCELLENT opportunity for experienced sales executive to develop new sales division for domestic and industrial thermostats and heat control equipment. Applications from men with the requisite experience and qualifications should be sent in writing, in full confidence, to the Sales Manager, R. B. Pullin & Co. Ltd., Phœnix Works, Great West Road, Brentford, Middlesex. 3016

MAINTENANCE technician required by the Atomic Weapons Research Establishment, Aldermaston, Berks., to supervise industrial staff engaged in the installation, repair and overhaul of electrical plant and services, and to operate a planned maintenance system. A recognised engineering apprenticeship and considerable experience in the above duties required. O.N.C. or equivalent qualification essential. Shift hours may be necessary. Salary £755 (at age 28) to £875 p.a. Contributory superannuation scheme. A house or assistance towards legal expenses on house purchase will be available for married officers living beyond daily travelling distance. Postcards for application forms to the Senior Recruitment Officer at above address. Please quote ref. 1770/48. 2995

MARKET research. Man required to study existing and potential markets for non-ferrous metal products. Training in commercial subjects and interest in technical processess desirable. Must be capable of working on own initiative. Write details of personal history, age, education and salary desired to—E. & E. Kaye Ltd., Ponders End, Enfield, Middx. 3018

MERCURY vapour and sodium discharge lamps. Independent lamp makers intend to commence the manufacture of discharge lamps. Openings are available for technicians capable of building up and managing this undertaking. Applicants should state previous experience and salary required. Good prospects and progressive post for ambitious men.—Box 3017.

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SALES manager. Manufacturers of Tenby electrical accessories require for their head office in the Midlands a first-class man to undertake the promotion and supervision of home and export sales. This is a permanent and pensionable appointment carrying good salary for suitable applicant. Full particulars by letter.—S. O. Bowker Ltd., Warstone Lane, Birmingham, 18. 3028

SALES office assistant (male) required for non-ferrous metal manufacturers. Work includes telephone contact with customers, pricing, correspondence and statistical work. Study of commercial subjects and interest in technical processes desirable. Write details of personal history, age, education and salary desired to—E. & E. Kaye Ltd., Ponders End, Enfield, Middlesex. 3019

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SENIOR electrical design engineer is required for rotating machinery manufacturer. Must be able to work full designs from basic principle and have significant experience in this field. Ample scope, particularly for younger man with progressive outlook. Full details of experience, qualifications, age and salary required.—Box 3020.

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TECHNICAL sales assistant required with practical and theoretical experience of electrical engineering for sales office of manufacturer of electric arc welding equipment. Pension, canteen, welfare facilities, five-day week. Apply Murex Welding Processes Ltd., Hertford Road, Waltham Cross, Herts. 2881

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YOUNG warehouse assistant wtd. by elec. lamps distributors. Write fully—Box 9325.

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322

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Machine: McLAREN/BRUSH, Leeds, No. PP75562, 55 kVA, mounted on skid type chassis.
Engine: McLAREN, type MR4, Mark 2, No. 30450/567, 300/1,200 r.p.m., 88 h.p.
Generator: BRUSH No. 48193, 400/440 v., 3-phase, 50 cycles, BSS. 168.
Exciter: BRUSH No. 48194, 56 volts, 23 amps., continuous rating, BSS. 168.
Panel: No. 21/60660/242, 400/440 volts, 4-wire.
Auxiliary Starting Compressor: REAVELL Compressor, No. 124897, Job. 44483, PETTER Engine No. 1204774, PAC. 2.

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3-cyl. Diesel Engine by LISTER, water cooled, radiator and fan, 1,000 r.p.m., fitted with a governor.
20-gallon Fuel Tank.
Engine coupled direct to MAWDSLEY Generator, single-phase, 1,000 r.p.m., 230 v. A.C., 65.5 amps., continuous rating, 50 cycles, 15 kVA.
Total overall dimensions of each engine and generator is 8′ × 3′ × 5′ high.
Also included is an Instrument Panel and Voltage Regulator.

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A.C. and D.C. motors, generators, from stock.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. (Edgware 5566/9). 91

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PREPAYMENT and credit, 200/250 v. A.C., s/p., 50 c., 2½-100 A. Fixed or variable tariff. Reconditioned, fully tested and guaranteed 2 years. Prompt delivery, carriage paid.
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Fairfax Works, Fairfax Rd., London, N.8
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ABABCOCK & Wilcox water tube boiler will cut down your fuel costs; we can supply from stock. Two 40,000 lb. evap., 220 lb. w.p.; one 25,000 lb. evap., 200 lb. w.p.; 3,000 lb. evap., 400 lb. w.p.; Spencer Bonecourt boiler; also Marine, Cornish vertical, etc.—Burford, Taylor & Co. Ltd., Boiler Specialists, Burtayco House, Church Street, Middlesbrough (Tel. Middlesbrough 2622). 122

A.C. and D.C. 1/- Slotmeters. Guaranteed 2 years, 2½-50 amps. From 50/-. Repairs and recalibrations. See Billiard: Tradex Meter Co., Surbiton (Tel. Elmbridge 4487). 169

ALTERNATORS from ½ to 675kVA in stock, single and three-phase, all voltages and frequencies. Guaranteed. Many unused. Send your requirements.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford. 162

ALTERNATORS, generators, 1-100 kVA, all voltages. Specialists—Powerco Ltd., 312, York Rd., London, S.W.18 (VAN. 5234). 147

ALTERNATORS, 3-phase, all sizes in stock from 7 kVA up to 330 kVA.—Britannia Manufacturing Co. Ltd., 20/26, Britannia Walk, London, N.1 (CLErkenwell 5512). 24

BARGAINS in electric motors are always being obtained from A. Cooksley & Co. Ltd., 21/25, Tabernacle Street, London, E.C.2. Stocks include A.C. and D.C. motors, second-hand and new up to 30 h.p. Starters, slide rails and pulleys. Ring Mon. 3355 for your requirements. 50

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CABLE, underground, PILC/VIR/LC, ex London stock. Cutting orders same day delivery London area. Send for priced stock lists.—Batt Electrical Co., 6, Dock Street, London, E.1 (Tel. ROYal 5905). 316

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FLUORESCENT fittings, lamps, starters and control gear for home and export. Fully guaranteed by actual manufacturers. Send for catalogues. — The Anglo-American Electrical Company, Olive Street, Bury, Lancs. 245

FLUORESCENT tubes reconditioned and guaranteed as new for 7s. 6d. each. Free collection and delivery in Lancs and Yorks.— The Anglo-American Electrical Company, Bury New Road, Breightmet, Bolton, Lancs. (Telephone, Bolton 7251). 212

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HIGH frequency alternators and converters, 400 to 2,600 cycles up to 6 kVA in stock. Powerco Ltd., 312, York Rd., London, S.W.18 (VAN. 5234). 149

HOUSE service meters, C. & H., Aron. E.A.C., 20-240 v. A.C., 1.-ph., 50 c., 5 amps., 17s. 6d.; 1s. 6d. postage.—Universal Electrical, 217-221, City Rd., London, E.C.1. 37

MOTOR generator sets and converters, all sizes and voltages from ½ kW up to 500 kW in stock.—Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, City Road, London, N.1 (Tel. Clerkenwell 5512, 5513 & 5514). 12

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POLYPHASE kilowatt hour meters. Available from stock.—Universal Electrical, 221, City Road, London. E.C.1. 40

PREPAYMENT 1s. slot house service meters —Universal Electrical, 217-221, City Road, London, E.C.1. 36

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QUARTERLY Credit Meters, single & polyphase, 2½-100 amps. From 17/6d. Also D.C. See Television.—Tradex, Surbiton. 171

ROTARY converters in stock, all sizes: enquiries invited. — Universal Electrical. 221. City Road, London, E.C.1. 34

SMALL BR screws and nuts in steel, brass and stainless steel, from stock.—Premier Screws & Repetition Co. Ltd., Woodgate, Leicester. 180

SLYDLOK fuses for sale.—Ryness Supplies, 37, Goodge Street, London, W.1. 284

SURPLUS Pyrotenax cable, from 1 × .04, 2 × .003 to 1 × .0145. List on application. Nett trade, less 10%.—Truman Elec. Co. Ltd., 40, Bridge St., Walsall (Tel. 2198). 2902

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TAILOR-made control panels for heating and motor loads. Compact and totally enclosed. Competitive prices. — Green Bros. (Electrical) Ltd., Brackley, Northants. 2970

TELEVISION slotmeters & Time Switches Details from: Tradex Meter Co., Surbiton Elmbridge 4487. 172

VENNER time switches. 200-240 v. A.C. D.C., 10-50 amps., from stock.—Universal Electrical Co., 221, City Rd.. London. E.C.1. 38

WARD Leonard motor generator sets, all sizes.—Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, London, N.1 (Tel Clerkenwell 5512). 12

2 Brush 200-kVA oil-cooled transformers with tappings, 6,600/416 volts, 3-phase, 50 cyc.; 1 Reyrolle type C, floor mounting, oil-immersed T.P. circuit breaker, 6,600 volts, 3-phase, 50 cycles, 20 amps., fitted with o/l releases; 1 ditto, rating 30 amps. All in first-class order.— J. J. Williamson & Sons (Canterbury) Ltd., St. Mildred's Tannery, Canterbury. 9327

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WALKER, WALTON & HANSON
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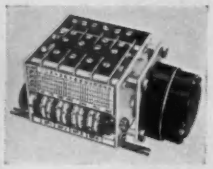

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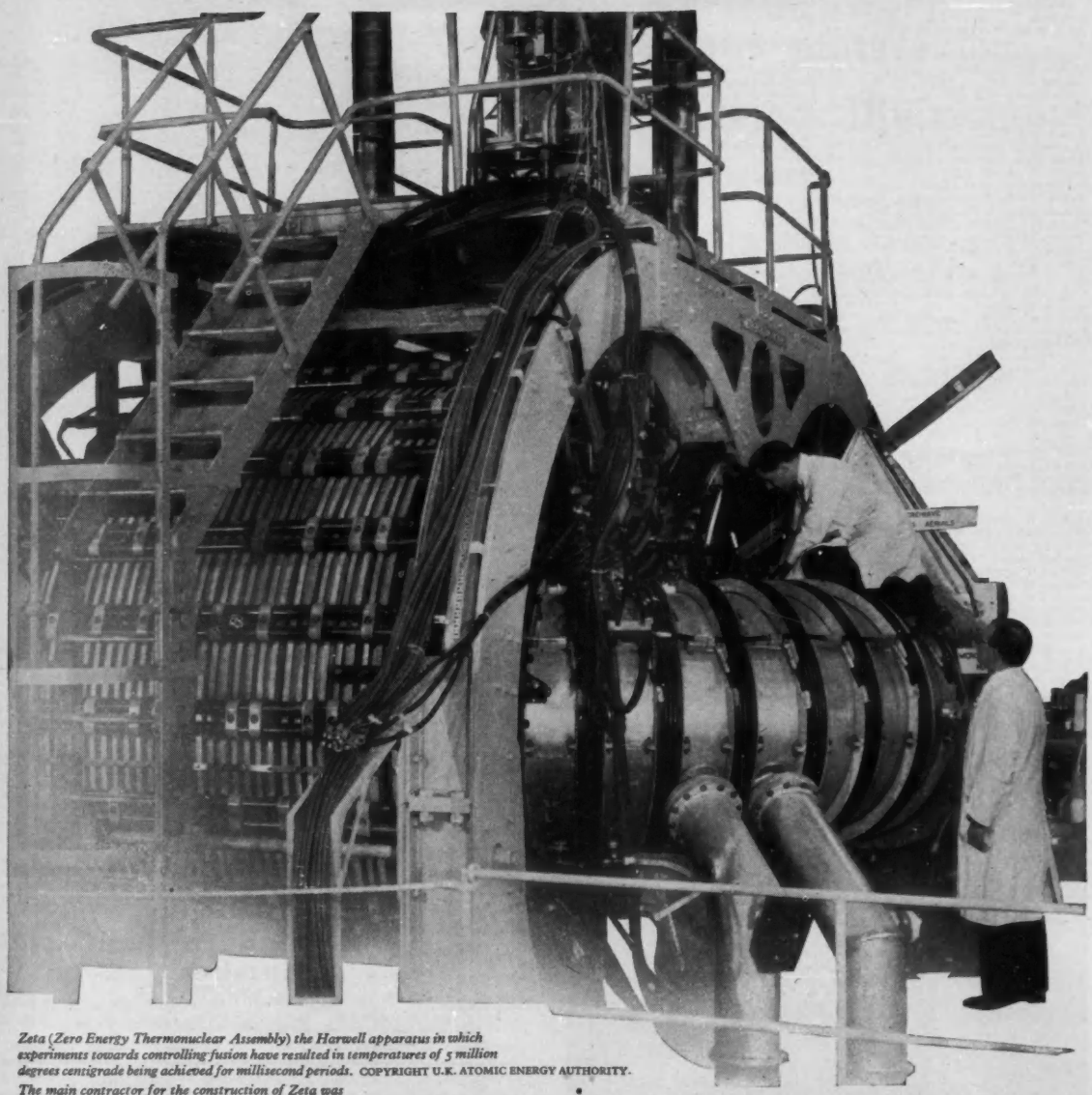

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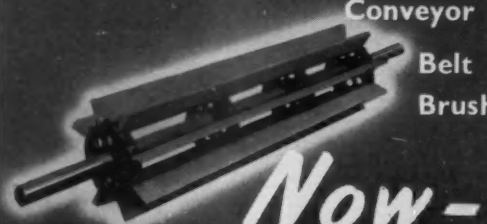

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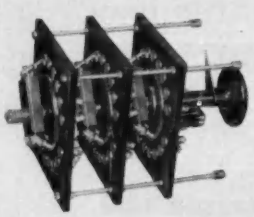

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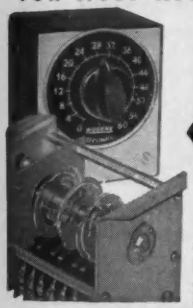

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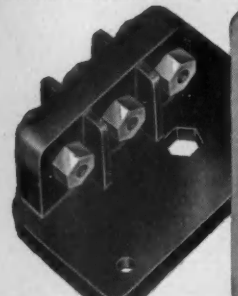

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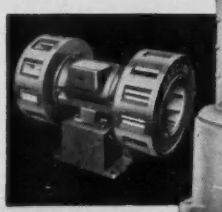
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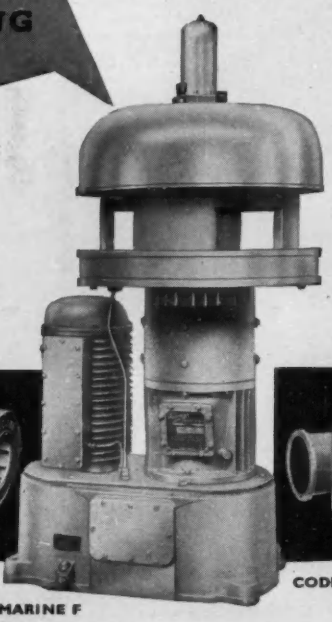
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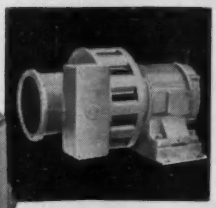
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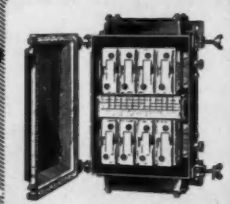

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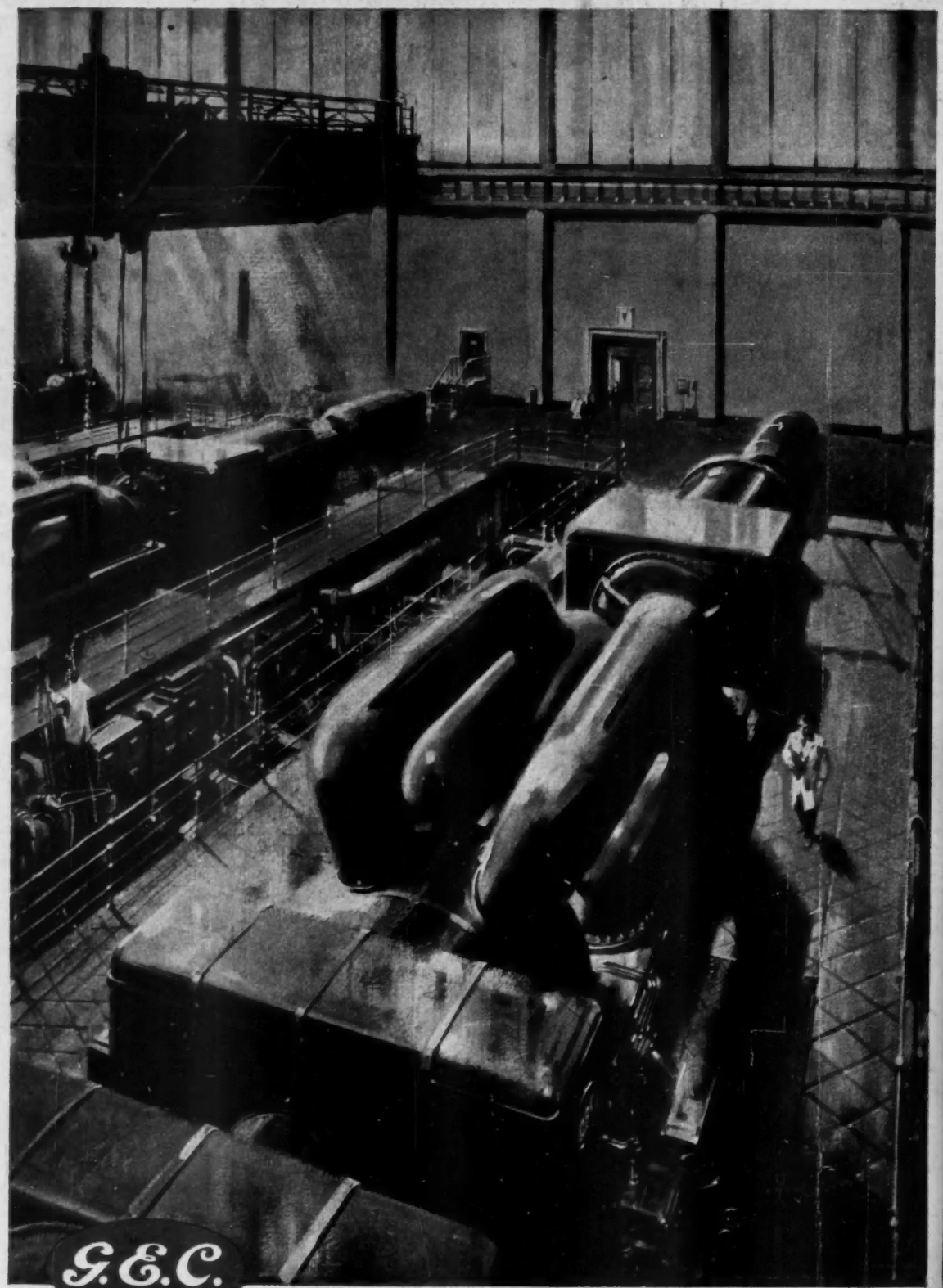

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